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The Heating and Ventilating Magazine

VOL. XIV. NO. 1

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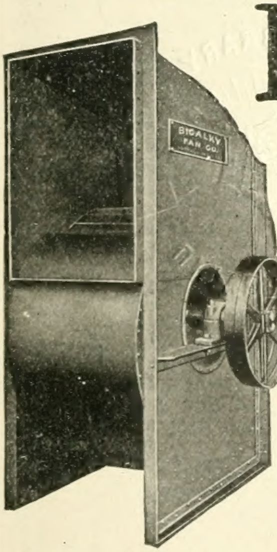

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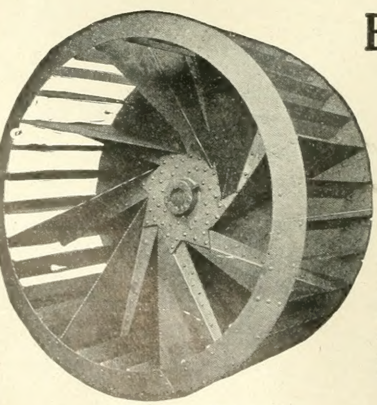

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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. JANUARY, 1917 1123 Broadway, New York

Air Conditioning Problems in the Manufacture of Ammunition

A Plant That Has Met Unusually Difficult Requirements.

By J. I. LYLE

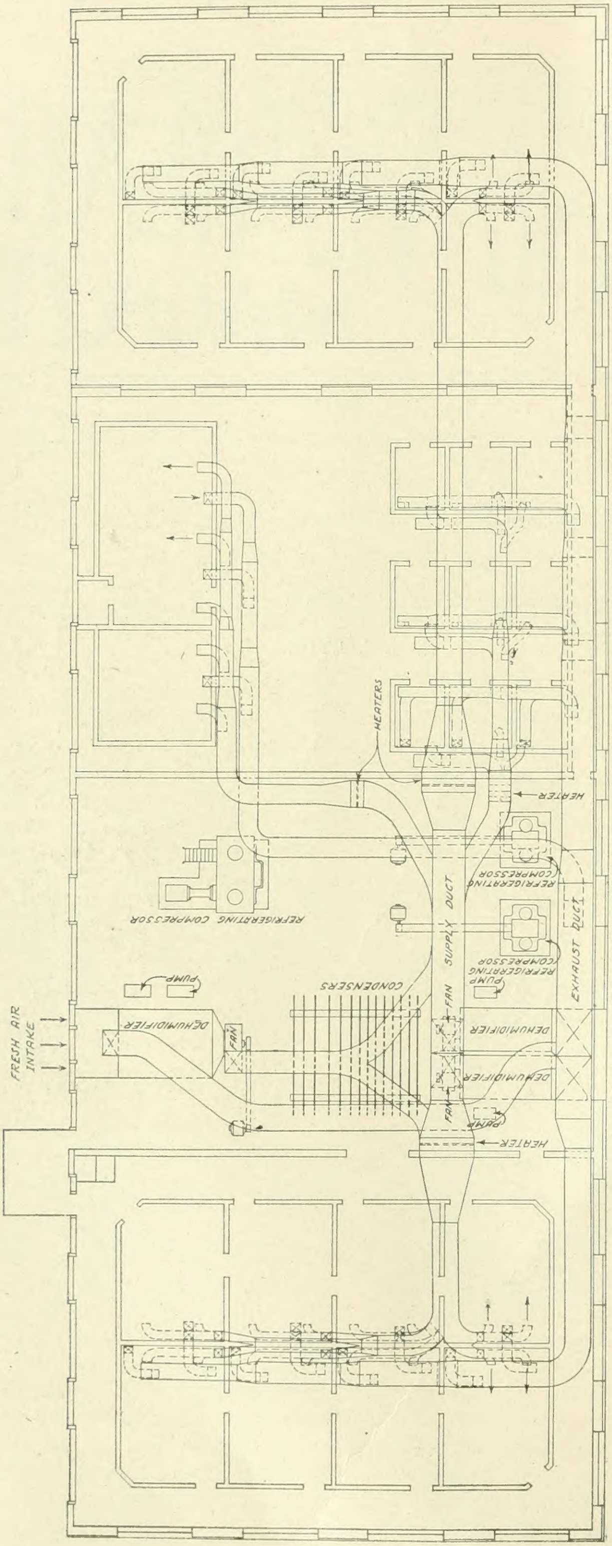
Time fuses for shrapnel shells must be capable of setting for explosion of the shell anywhere from within 16 ft. of the muzzle of the gun to a distance several miles away, while the shell is traveling at a velocity of 1,700 ft. per second, or about 20 miles per minute. Two shells set for exploding at one mile and fired consecutively should function within 40 ft. of each other.

The accuracy of firing is absolutely dependent upon conditioning the powder, and as the powder used in a time fuse is very hygroscopic, the humidity of the atmosphere in which the fuse is loaded must be maintained within a total variation of less than 2%.

Extremely accurate control of humidity and temperature is, therefore, one of the first essentials in a fuse-loading plant, and inasmuch as 24-hour per day plant operation is necessary and as later deliveries are generally penalized in this class of work, the air conditioning system, like all other apparatus, must be designed and installed with every precaution for uninterrupted operation.

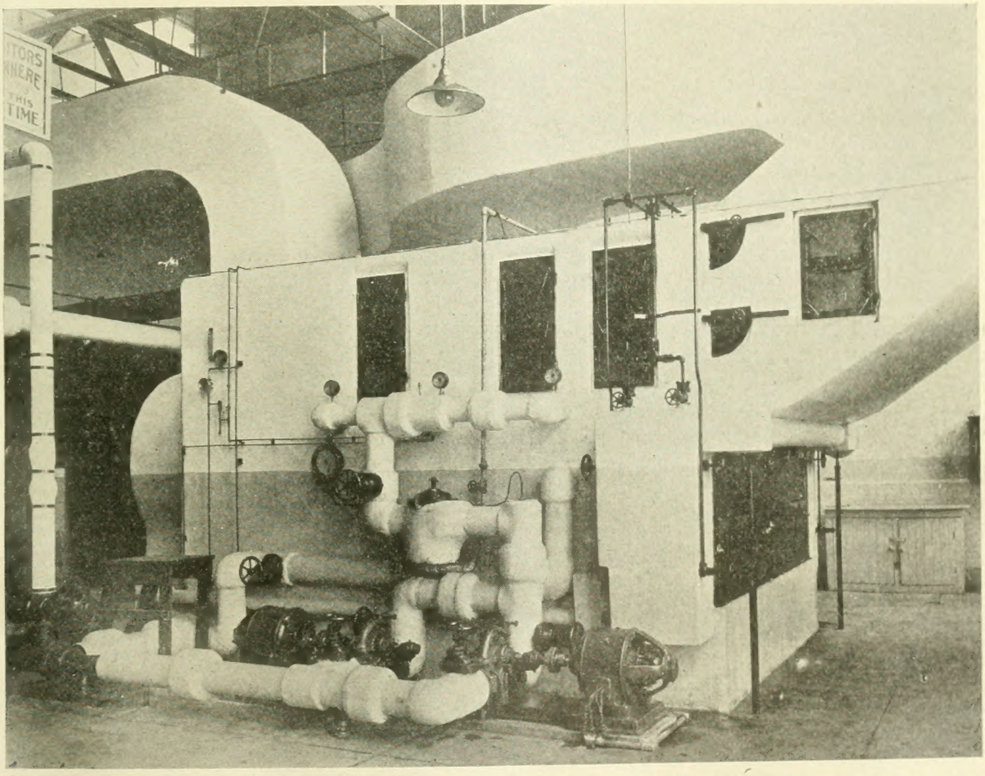
The methods and apparatus by which satisfactory air conditions are being maintained by one of the prominent American munition makers are indicated by the accompanying floor plan and photographs. It will be noted that the actual loading operation is carried on in numerous small rooms housed inside of a larger building, an arrangement which shields the work from the rapid fluctuation of outside weather conditions that would otherwise tend to impair the accuracy of control. These rooms are provided with conditioned air from a Carrier system that maintains temperature uniformly at 70° F. and proper relative humidity at all times. Provision is also made in a number of experimental rooms for varying the air conditions over a wide range.

Reference to the layout shows two sets of ducts, one having an opening in each room for admission of correctly conditioned air and the other having similar outlets for carrying away the air as its temperature and humidity characteristics change. In other words, each room is merely an enlargement in the circulating system in which a complete change of air occurs every few minutes. This arrangement also provides ample ventilation for all operatives, keeping them able and ready to do efficient work, and at the same time carries away the small particles of powder that float into the air. These particles are moistened in the air conditioning apparatus and



LAYOUT OF AMMUNITION PLANT, SHOWING LOCATION OF PARTS OF THE AIR CONDITIONING SYSTEM.

carried to the bottom of a settling tank from which they can be removed without doing any harm.



ONE OF THE DEHUMIDIFIERS, SHOWING DUCTS, PIPE CONNECTIONS, INSULATION, INJECTOR HEATER AND WATER CIRCULATING PUMPS.
(Condensing Coils of the Refrigerating System at the Rear.)

The air is circulated by a Conoidal type of centrifugal fan, discharging into galvanized iron ducts, but before it enters the fan and discharges through the distributing ducts in the building, it is first drawn through Carrier apparatus arranged to act sometimes as humidifiers and sometimes as dehumidifiers as the weather changes may demand in maintaining the uniform standard. The air leaving this apparatus is saturated at a definite temperature and has a definite moisture content. This is accomplished by interposing fine sprays of water into the path of the air within a sealed chamber, the temperature of the water being regulated to produce the desired dew point. When the water must be heated to do this, steam is injected into the it on its way to the spray nozzles, and if a cooling effect is necessary this is secured by using cold well water or refrigeration. In either instance, automatic regulation is provided to keep the dew point constant.

For reasons of economy of heat in winter and for refrigeration purposes in summer, the air is largely returned from the building, purified and recirculated, together with a small "makeup" from outside.

Dampers are provided in the fresh and return air inlets and are automatically regulated to take from each source the proportionate amount of air to give the desired temperature. Additional dampers are provided in the fresh air inlet so this may be closed absolutely tight when no air is taken from the outside. Summer and winter humidity controls in each room make the regulation very accurate.

Vento heaters operating with steam and placed in the discharge ducts can be used, where necessary, to raise the temperature in winter time to the desired degree.

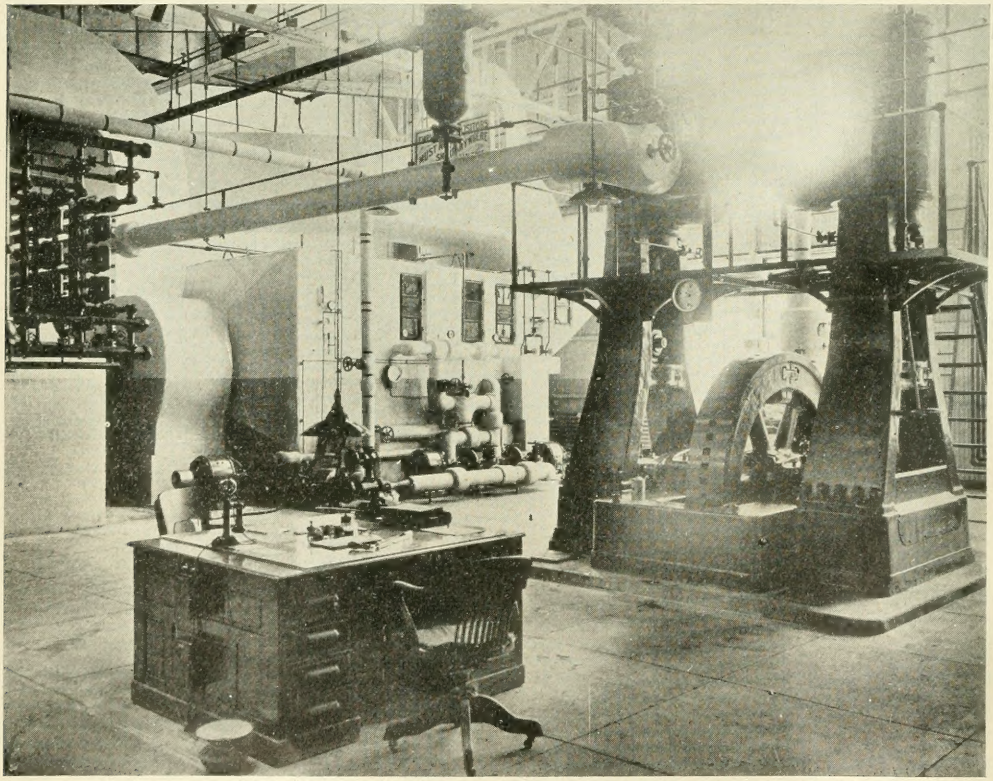
At times when the outside air contains too much humidity, especially in hot weather, the excess moisture is removed by the units acting as dehumidifiers. This is done by cooling the air as it passes through, to lower the dew point and condense the excess. The water used in the spray chambers in this instance is cooled by passing over sets of direct expansion Baudelot coils, located in a compartment below the spray chamber and which are operated only at times when needed.

The original installation consisted of two Carrier self-contained dehumidifiers equipped with summer and winter dew point control, and in which the Baudelot coils are located in separate chambers directly beneath the spray chambers, which in this instance are about 7 ft. wide, 15 ft. long and 10 ft. high. Each unit was provided with two pumps, cross-connected so that one was always held in reserve for emergency. Likewise the fan (belt-driven) of each unit was provided with two motors, one for regular duty and the other for emergency.

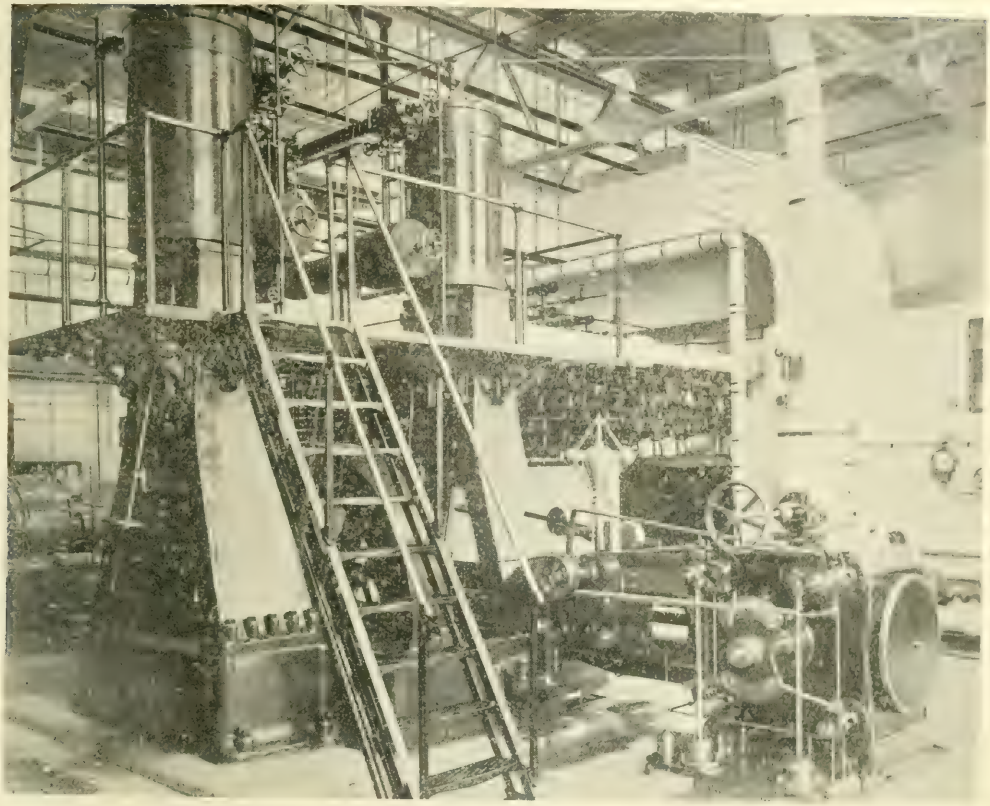
The body of each dehumidifier is insulated by a covering of cork board and Portland cement and all ducts are covered with Nonpareil cork board and an outer layer of canvas.

The refrigerating machinery consists of two vertical single-acting York ammonia compressors, belt-driven by 60 h.p. direct-current motors. These motors are designed for a wide speed variation by means of field control, which keeps the efficiency of the motor at a high point for all speeds. The condensers are of the double-pipe type so that they could be located within the apparatus room.

Subsequent to the original installation, increase in the size of the plant demanded additional air conditioning equipment. Another unit similar to the



ONE OF THE DEHUMIDIFIERS AND AMMONIA COMPRESSORS.
(Part of the Condensing Coils Shown at the Left.)



THE ENGINE-DRIVEN AMMONIA-COMPRESSOR AND CONDENSING COILS USED AS PART OF THE SECOND INSTALLATION.

first two, but slightly larger, was then added and connected to deliver into the system of ducts already installed.

The refrigerating machine, in this instance, however, consisted of a vertical single-acting ammonia compressor, direct connected to a horizontal Corliss engine.

The idea, as carried out in this plant, of installing extra capacity and duplicating all parts subject to accidental damage or break-down, so that continuous operation is always possible with little or no delay, has worked out very well, and proven well worth the added cost.

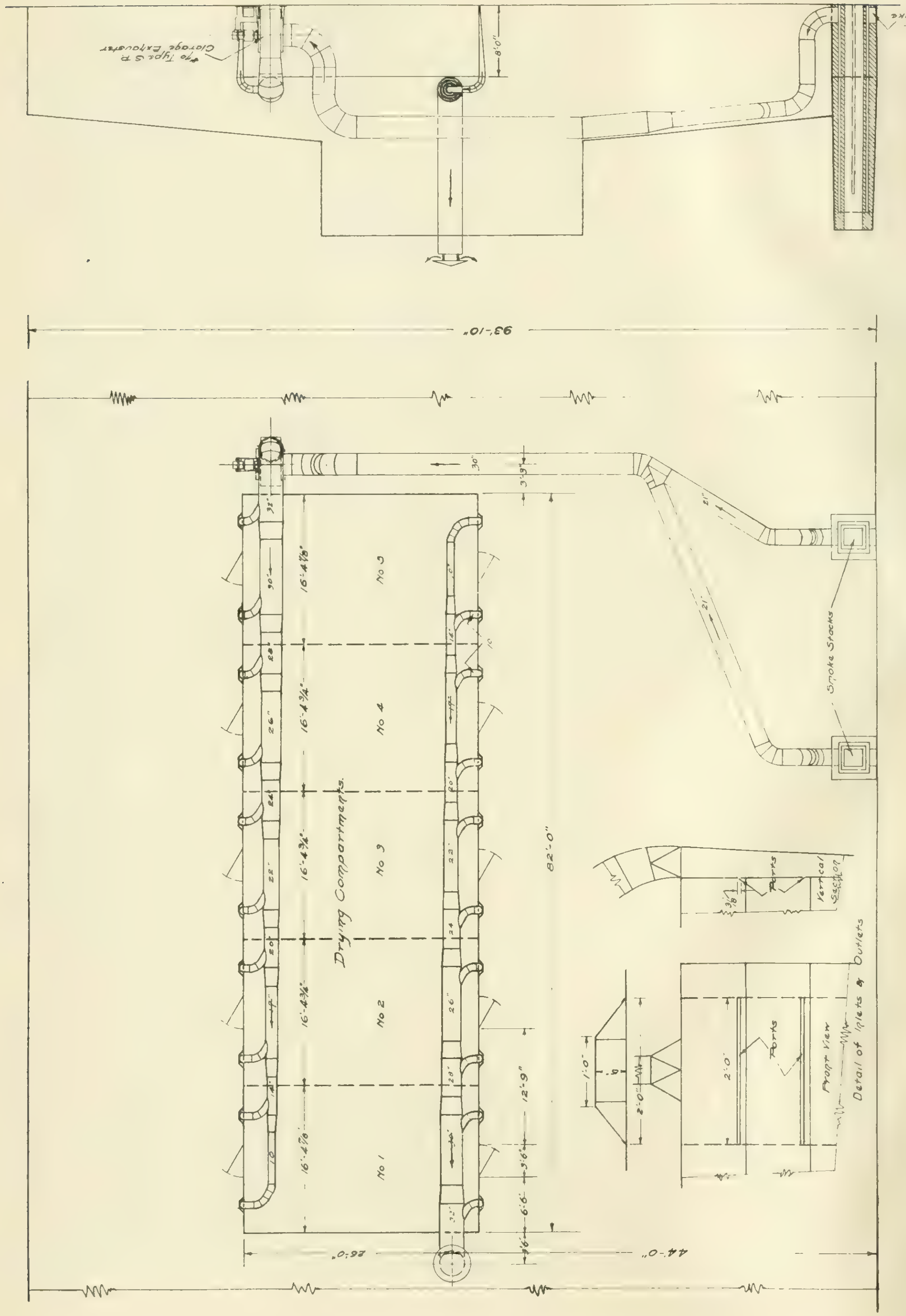
Accurate records which have been kept of humidities and temperatures indicate that the control has been as dependable as could be desired.

Utilizing Waste Heat for Drying Purposes

Obtaining steam or hot water by means of economizers is not a new thing in the field of engineering, but the utilization of waste heat from smoke stacks to obtain heated air for drying purposes or for ventilation is a recent and interesting development.

In the plant of the Detroit Stove Works—the largest manufacturers of stoves in the world—the air, passing through a chamber which surrounds the smoke flue and which is built in the stack, is heated to a temperature suitable for drying various kinds of material.

The source of heat is a bank of four



LAYOUT OF SPECIAL DRYING APPARATUS FOR DETROIT STOVE WORKS.

enameling ovens connected to two square stacks. These stacks are built with wall especially thick in order to prevent radiation losses, and measure 5 ft. outside at the base and are 25 ft. in height. The smoke flue of the stack, 2 ft. square inside is surrounded by a 5-in. chamber extending from the bottom of stack to within 2 ft. of the top.

This chamber is divided into two parts by a baffle so that outside air, which enters at the bottom, travels up one side and down the other and is drawn out at the bottom into the piping system. During its travel the air passes over 176 sq. ft. of surface which radiates enough heat to raise the temperature of the incoming air from 20° F. to 152° F. From the volume of air handled and rise in temperature it was computed that the two stacks gave off 1,053,000 B.T.U. per hour. The same amount of heat, on the basis of like quantities of air and temperature rise would be obtained with five sections of pipe coil heater containing 820 lin. ft. of 1-in. pipe and operating under 30-lbs. steam pressure.

Pipes losses are sufficient to reduce the temperature to 140° F. in the dryer. This dryer, 82 ft. long, 26 ft. wide and 8 ft. high, is divided into five compartments. At opposite ends of each compartment are 16 inlets and 16 outlets. These distribute the air evenly over pipe racks upon which the enameled steel sheets are placed for drying. Since the enamel holds approximately 4 lbs. of moisture per 100 sq. ft. of surface, it is necessary to thoroughly dry the sheets before placing them in the intense heat of the enameling ovens. This drying process gives the enamel a smooth finish. Changing the air every 2½ minutes in each compartment, the material dries in 15 minutes.

The air is forced through the system by means of a No. 70 Clarage type S. P. exhaust fan. This fan delivers 6,750 cu. ft. of air per minute against 3 in. static pressure, when running at 550 R.P.M. Under these conditions, it requires 5.5 brake horse-power to drive.

The engineering department of the Clarage Fan Company, Kalamazoo, Mich., designed the entire system of dryers, piping system, etc., while the actual installation was made by the Detroit Stove Works.

Returning Condensation to the Boiler

Several Methods That Are Particularly Suitable for Industrial Buildings.

By HAROLD L. ALT

Getting steam to a radiator is often only half the story and sometimes the smaller half. Especially is this so in industrial heating, where long runs of return pipes are the rule and high steam pressures the only source of steam supply for the heating system. There are four general conditions under which the returns will trouble the heating engineer and these may be classified as follows:

1. Where a high pressure boiler is used to supply steam to the heating system through a reducing valve.
2. Where the size of the job, length of runs, etc., make a gravity system impractical.
3. Where radiators are below the level of the boiler water line or of the return line to which they must be connected.
4. Where the initial cost and maintenance of the required extraordinary length of return pipe is not offset by a sufficient saving in the water returned and heat saved.

Almost all heating return difficulties come under one, or a combination, of the above heads.

When returns cannot be made to reenter the boiler by a plain gravity action the most common expedient employed is the ever-useful steam trap. Yet in spite of its frequent use little real knowledge is found among its employers as to its capacities, service and length of life.

One reason for this, undoubtedly, is the vast variety of traps which have been invented from time to time and the generous assortment in common and everyday use. In general, however, traps may be classified in two ways; either by the service they perform or by the method employed for their operation.

CLASSIFICATION OF TRAPS.

On the service basis there are four large general divisions, these being *return traps* (which return condensation back and into the boiler if located at a higher point) *free discharge traps* (which will discharge condensation into some receptacle where the pressure is less than trap pressure—usually against atmospheric pressure only) *lift traps* (which raise the condensation water by means of high pressure steam applied to the trap periodically) and special traps for vacuum apparatus, etc.

Classified according to construction and operation there are pot or bucket traps, float traps, thermostatic traps, differential traps, tilting traps and other special designs.

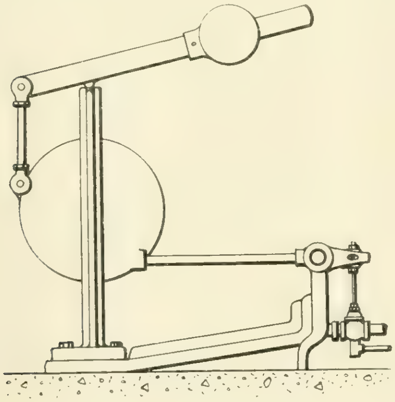


FIG. 1.—BUNDY TRAP.

It is not within the scope of this article to delve into the construction or operating principles of the various traps, it being intended only to discuss their proper utilization. Their standard sizes and various characteristics are briefly noted below:

STYLE "A." Common *separating, drip, non-return* or *tank* traps which discharge into atmosphere, or open receptacle such as a hot well, heater or tank but never back into the boiler. Such traps will also *raise* the discharge water against atmospheric pressure a distance of *two feet* for every *pound of steam pressure* on the line which they drain. They may be used on any inlet pressure up to 140 lbs. and are usually made in sizes ⅜ to 3 in. Similar traps for pressures up to 250 lbs. are obtainable in some makes in sizes from ⅜ to 1¼ in.

Such traps have only two connections, an inlet through which the condensation and steam enter the trap and the outlet through which the condensation is blown out into the pipe leading to the point of discharge. Whenever the point of discharge is higher than the trap the delivery efficiency will decrease 1 lb. for every 27 in. of lift.

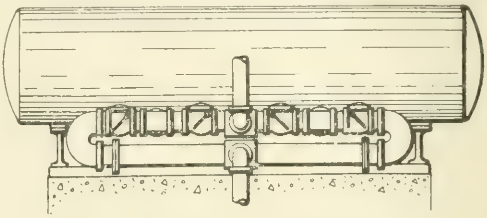


FIG. 2.—FARNSWORTH TRAP.

This type of trap has no vent.

STYLE "B." The common *"return"* or *"direct return"* trap is a term designating a trap *returning* the water of condensation to the boiler from a system operating at a lower pressure. This is accomplished by setting the trap a distance of at least three (or, preferredly, four) feet above the water line and then automatically applying the high steam pressure to the trap wherever it fills with water. The resulting steam pressure above the water in the trap, counterbalancing the steam pressure below the water (in the pipe leading to the boiler), the water sinks down by its own weight into the boiler. As soon as the trap is emptied the high pressure steam is cut off, a vent opened to relieve the pressure and the trap chamber is again ready for refilling at the lower pressure.

These traps have four connections, the inlet for condensation, the outlet for condensation, the high pressure steam inlet, and the vent pipe for the relief of the pressure after discharging. The vent pipe is usually connected into the ash pit.

This trap will also lift its discharge to any height within the limits of the high pressure steam applied and is usually made in sizes ¾ in. to 4 in.

STYLE "C." The *lift, three valve* (or *pumping* trap, as it is sometimes called) is the same trap as described for the return trap with similar connections. This trap will not return water to the boiler owing to the fact that the head of water due to the lift prevents a counter-balancing of steam pressure so that a lift trap is to a great extent only a farther development of the trap described in Style "A." For instance if a tank trap did not have sufficient pressure on the inlet to raise its discharge up to the desired point a lift trap could be substituted and, with its higher steam pressure connection, would undoubtedly do the trick.

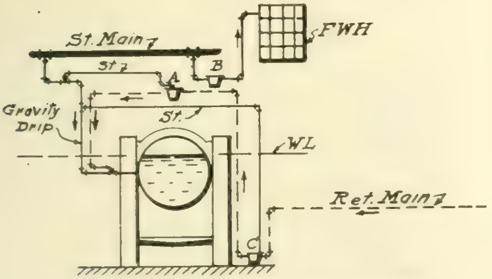


FIG. 3.—THREE USES FOR TRAPS.

Again a return trap set 4 ft. above the water line of the boilers might be so far above the lowest point of a heating system that a return trap—Style "B" would not have a sufficient lift capacity to force the water up to the desired level. In such a case the lift trap (probably combined with a receiver) would be substituted. The sizes, connections, and other details are the same as described for Style "B." The most successful types of lift traps are known as tilting traps—that is those which fill and tilt to operate. Two types of such traps are shown in Figs. 1 and 2.

As an illustration of typical uses of the three kinds of traps Fig. 3 is given in which a Style "B" trap returns the water of condensation to the boiler after the condensation has been lifted into it by the Style "C" lift trap which is below the boiler water line WL. Another portion of the steam main is dripped through a Style "A" trap which discharges into the feed water heater FWH.

In some cases one trap will do the whole work while in other cases two must be employed. Thus, if the return from a low pressure heating system can be brought back to the high pressure boilers at a point say four feet above the water line it can be returned direct to the boilers by a Style "B" direct return trap located at this point. On the other hand if the return line were at floor level of the boiler room then a second trap is needed to lift the return up into the direct return trap. This second trap may be an ordinary Style "A" tank trap—which will lift its discharge water approximately 2 ft. for every pound gauge pressure at the inlet—provided that the pressure in pounds on the return line at the lower trap is not less than one-half the vertical distance in feet between the two traps.

If the lift is too much for the pressure to be carried in the heating system

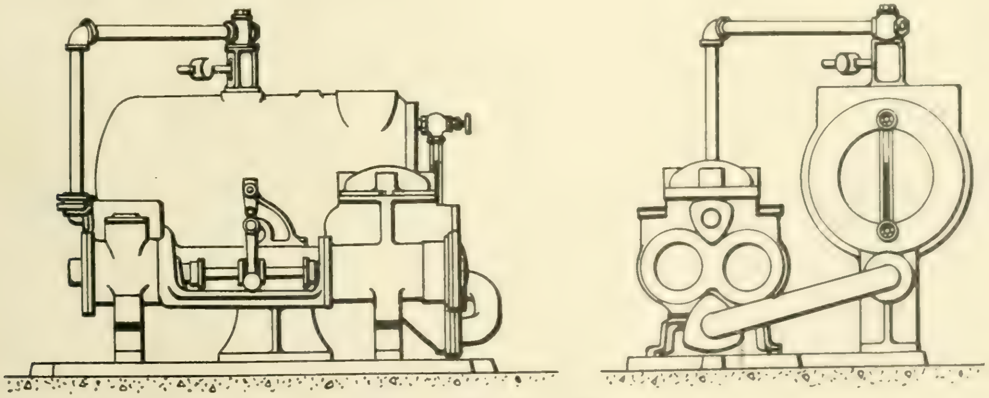


FIG. 4.—RECEIVER PUMP.

(and therefore the one which would have to be used for a style "A" trap) then the Style "C" lift trap operated by high pressure steam must be used. It makes no difference if the condensation is discharged into a feed water heater or open tank instead of being raised into a direct return trap the same requirements prevail as to the use of a tank or a lift trap. When several returns are to be cared for by one trap a receiver is recommended, this receiver being set a little higher than the lower trap. If the receiver is *vented* a Style "C" *lift* trap must be used because there will then be no pressure to operate a style "A" tank trap.

In cases where large quantities of condensation are produced at concentrated points (such as fan rooms) and also when the return line has to be run with numerous changes in elevation a receiver pump similar to that shown in Fig. 4 is employed to pump back the returns especially where these are of considerable magnitude.

Where receiver pumps are used they may be motor-driven, but are usually plain piston steam pumps with the exhaust discharged through an oil separator into the heating steam main. When so treated the cost of operation is practically nothing, but the expense of carrying a high pressure steam line to the pump location and the heat losses therefrom may be so great as to make an electric drive desirable.

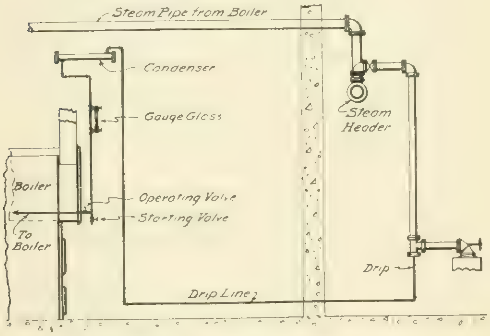


FIG. 5.—STEAM LOOP.

Receivers may be closed, or vented, as governed by the conditions under which they are installed. For instance if the receiver serves only one steam system all of which operates on the same pressure (so that the returns are also all at practically the same pressure) a closed receiver may be used with a balance pipe from the steam line connected to the top so as to equalize the pressure in the receiver. The several returns connected to such a receiver should either be run into it separately or should be effectually water-sealed by connecting to a main return line located well below the water line of the receiver.

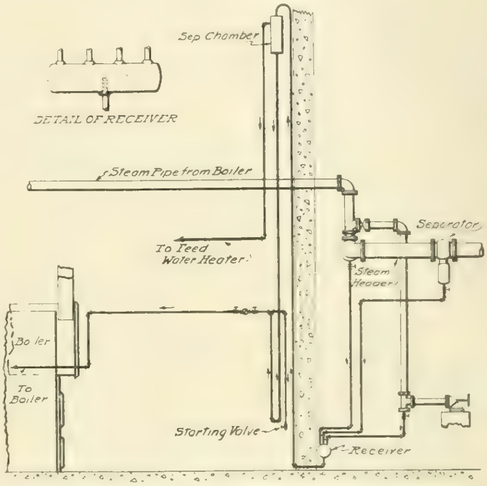


FIG. 6.—HOLLY SYSTEM.

On the other hand if the receiver is to take care of the condensation from several different pressures (such as laundry apparatus, cooking equipment, hot water heaters, and heating systems) each return must be separately trapped, the traps discharged to the receiver and the receiver vented to the atmosphere to prevent the accumulation of pressure due to the higher pressure trap discharges.

PROVISIONS WHEN VACUUM HEATING SYSTEMS ARE USED.

When heating systems get too large (as they often do in industrial work) to operate satisfactorily with a gravity two-pipe system, vacuum heating is almost invariably adopted. Contrary to the idea held by some vacuum heating does not mean a vacuum carried on the steam lines but, on the contrary, it does demand that a vacuum be carried on the return lines. In such systems the air and condensation pass out of the radiators through a trap of the thermostatic or water-seal type being drawn through the trap (whenever it is open) by the vacuum maintained in the return line.

This vacuum is produced by a vacuum pump (which handles both air and water) taking its suction from the line and controlled so as to maintain any desired degree of vacuum and it not only serves to draw the condensation back to the pump along a return pipe run with a gradual slope toward the pump but will also pull the returns up hill to a limited extent. This is done by making use of a lift fitting and the lift, in low vacuum systems, is usually limited to four feet or so; on systems when a higher vacuum is used the lifts may be made much larger the writer knowing of a case where a 15-ft. raise was accomplished but such high lifts should be avoided. The vacuum pumps discharge the air and water to an air separating tank from which the water enters the feed water heater.

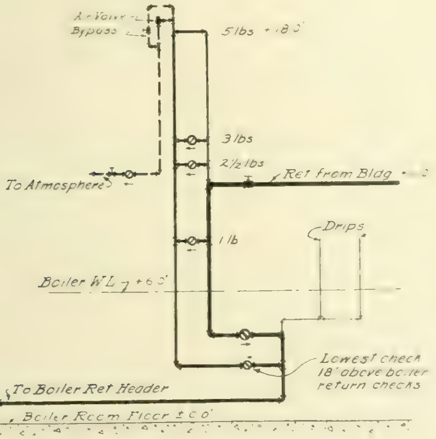


FIG. 7.—MODIFIED STEAM LOOP.

High pressure drips are often returned by means of the steam loop which consists of an arrangement of piping such as is shown in the typical case illustrated in Fig. 5. The prime mover of the loop is the condenser, the operation being as follows:

The condensation settles down in the bottom of the loop and is then drawn up into the condenser by the gradual condensing of the steam entrapped between the condenser and the water in the bottom of the loop. The water drops into the condenser and then flows by gravity from that elevation down into the boiler. It can readily be seen that the height at which the condenser must be set is such that the head of water between the condenser and the boiler water line will develop sufficient pressure to overcome the pressure drop in the steam line, the pipe friction of the loop and the resistance of all the check valves. To start the system the starting valve is opened until all the air is blown out and steam appears at which time it is shut off and the valve going to the boiler is opened. The loop will then continue to operate automatically.

Where several drips are to be cared for and where they are liable to be under slightly different pressures owing to variations in pressure in the different portions of the steam line, a Holly system is used. This is illustrated in Fig. 6 and is not essentially different from the loop except that a receiver is used into which all the drips are connected. Out of the bottom of this receiver a perforated pipe is taken and carried up to a point high enough above the boilers to produce the desired head on the water pulled over the loop.

The motive force in this system, however, is not caused by the condensation in the condenser but instead a pipe is taken from the elevated chamber and connected into the feed water heater. A slight flow of steam through this pipe controlled by a throttle valve will cause the water collecting in the bottom of the receiver to be carried up over the loop and from this point it will fall into the boiler by its own weight, similar to the action in the simple loop.

VARIATION OF LOOP IDEA.

A rather original variation of the loop idea is used in some of this New York schools where the vacuum systems are operated by gravity during periods outside of the regular sessions. Owing to the vacuum traps on the radiator returns the creation of any pressure in the boilers will back the returns up in the return main similar to the action secured in a modulation system and to avoid flooding the return main the loop shown in Fig. 7 is used. The condensing steam in the return line creates a vacuum in the return side of the loop and the pressure in the boiler holds the water up in the boiler side of the loop. As soon as the vacuum in the top of loop is sufficient the returns are drawn up and pass across through the checks into the boiler side. Here, as before in the simple steam loop, the hydrostatic head accumulates until the water passes down through the lower checks and into the boiler.

This accomplishes only what other standard devices will do automatically but as a study in loop returns it is most interesting.

Where the return lines are too long to pay to return the water of condensation a modulation system may be used with the returns drained to a sewer or a gravity system may be used with all the returns carried to a single trap which also discharges into the sewer. Of course, under these conditions both the heat of the returns and the water are lost.

Unusual Heating Demands for a Moving Picture Film Building

By GEORGE T. MOTT

The science of heat application, unlike that of electricity, is seldom spectacular, and for that reason we frequently hear the statement made that no progress is being made in the science of heating.

That this is far from the truth is evidenced by superficial observation, which will show that heating methods have advanced in practically the same ratio that building developments have demanded, not only in application, but in efficiency.

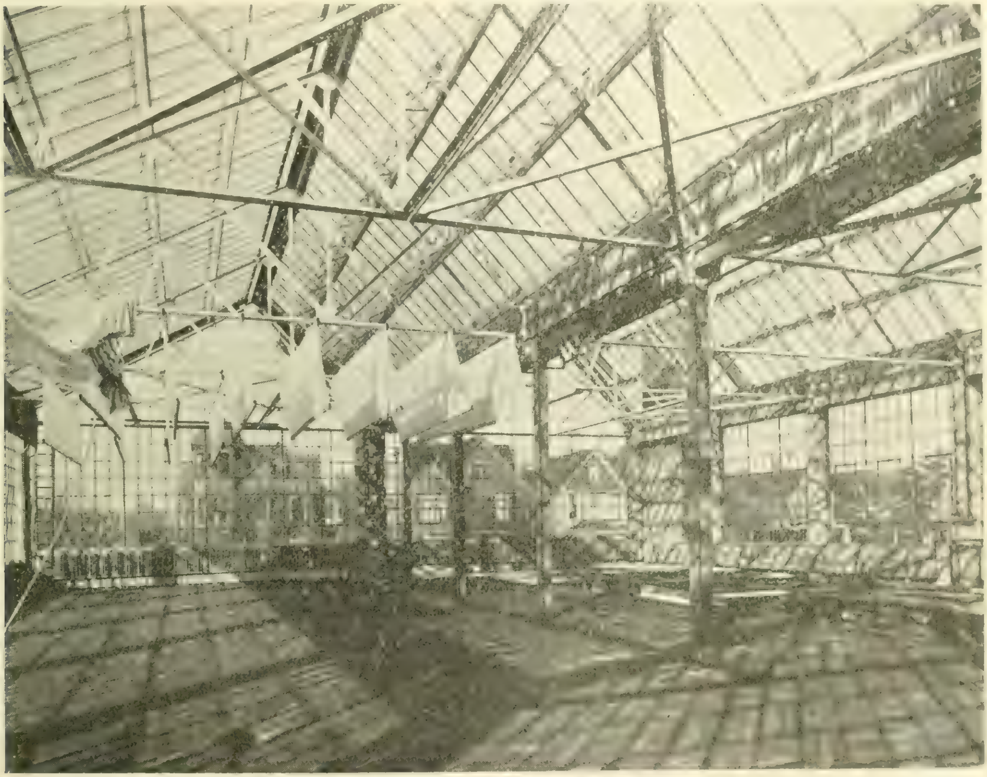
This advancement is particularly notable in the equipping of the industrial plant,—a growth which was made necessary by the great changes which have taken place in the industrial building, as well as the increased cost of anthracite fuel, and the constantly growing demand for a lessened overhead. The several factors of overhead as applied to heating, embrace not only interest on investment, depreciation and insurance, but also space conditions, and, in many instances also, a lighting factor. The modern plant with its extended glass area provides but little space for direct heating surface, and in consequence this surface to be adaptable must be sufficiently compact to avoid overlapping the glass areas. It is required also that it be relatively indestructible, to have a negligible depreciation, to be easily erected and capable of rearrangement with equal ease, to be sanitary and to be also capable of installation at a cost not in excess of previous practice. To accomplish this latter end, it must have a high transmission value and an absolutely dependable rating.

Having met these requirements, it is still necessary that the generating plant be placed on an equally efficient base, and here the terms of efficiency change somewhat and include not only investment, stability, space conditions, ease of handling in shipment and erection and a certified rating, but demands also a maximum thermal delivery to the plant from a low-cost fuel as delivered to the premises, and this with maximum labor and attention. These requirements, under existing conditions, eliminate anthracite fuel and substitute automatically the bituminous coals, which, particularly for

PLANT OF THE CENTAUR FILM CO., ON THE BAY FRONT, AT BAYONNE, N. J.

the Eastern territories, are relatively low in cost and uniformly high in thermal value. Incidentally, in the era of economy about to take place, these conditions will be accentuated.

That these rigid requirements have finally been met, is attested to by many plants all over the country. The illustrations given, departing as they do in a measure from the usual, approach the spectacular—and include the features of adaptability, compactness in a plant which demands this feature in excess, and above all a combination of maximum efficiencies.



STUDIO ON UPPER FLOOR OF CENTAUR FILM COMPANY'S PLANT.

Perhaps there are few better examples of application and efficiency of wall radiation than is evidenced in these illustrations, nor a more striking example of bituminous fuel consumption in a manner which adds to efficiency and complete smokeless consumption.

The plant in question, known as the Centaur Film Company, was erected by William Horsley, formerly manager of the Bigelow Boiler Works at New Haven for many years, and a "dyed in the wool" boiler man. Mr. Horsley, in the exercise of his expert boiler experience, endorsed for this plant, besides Rococo wall radiation, two No. 4128-S Ideal smokeless down-draft boilers for soft coal consumption, these boilers having a rating of 6,000 sq. ft. each in terms of column-type radiation. The total load on the plant is approximately 7,200 sq. ft., also in terms of column radiation, and this is uniformly carried by one boiler, the second boiler being used when the Vento surface, used in connection with the dry rooms, is thrown into action, or in excessively cold weather.

This plant has been in continuous operation since October, 1913, and the smokeless operation of the boilers is clearly observed by the clarity of the glass as shown in the roof, which glass incidentally has not been cleaned since the plant was put into commission. It will be observed that the stack projects

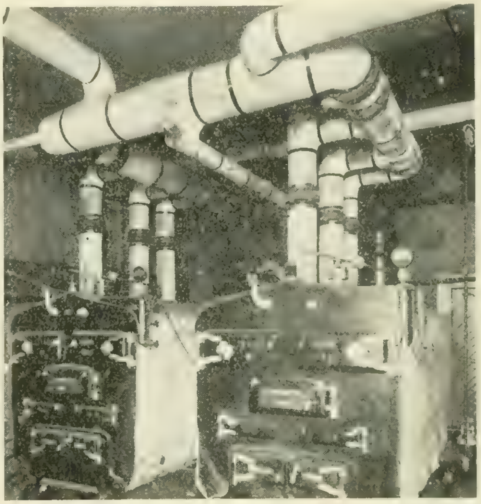
PART OF INTERMEDIATE FLOOR CENTAUR FILM CO., DEVOTED TO PROCESS WORK.

but slightly above the peak of the glass roof. This glass roof incidentally opens along its entire length on two sides.

The process of film development is particularly susceptible to damage, and the slightest particle of dust or grit from a stack deposited on a film would mean its complete destruction, in consequence of which it was required that ironclad guarantees be given covering the operation smokelessly, and with a complete absence of dust or cinders. The operation of the plant under these conditions has been continuous throughout the winter periods without protest. Incidentally, the plant has been subject to the variable fuels obtainable in the Bayonne industrial center, and has up to date comprised almost every type of low cost soft coal brought into the Eastern market. It is regrettable that we are unable to give the exact amount of fuel used in connection with the heating plant, but the intermittent service of the fan-drying system makes it difficult to separate the two services.

The building, as its name implies, is devoted to studio and film development work, and as such it is required that no part of the building at any time, regardless of external temperature, be below 70° F.—the upper floor in particular being kept at the tropical temperature of 80°. The Vento hot blast surface is applied only to the operation of film drying, this equipment being located in the basement and being operated intermittently. The building includes a total of approximately 300,000 cu. ft. and there is provided a total of 6,000 sq. ft. of wall radiation. The plant was installed by Diehl & Gross, under what is known as the Positive air return line system—a form of modified vapor installation which comprises but two air valves on the entire equipment. The plant throughout has the full and complete endorsement of President David Horsley, of the Centaur Film Company.

The illustrations shown give respectively the exterior, the upper floor which is devoted to studio work, and the intermediate floor which is devoted to process, the basement being devoted to development and drying. There is also shown an illustration of the boiler room which, however, is more or less incomplete, as the boilers at the time had not been completely covered.



BOILERS AND CONNECTIONS, PLANT OF CENTAUR FILM CO.

The building is of concrete construction throughout on a slight steel structure, and is situated in a highly exposed position immediately on the bay front at Bayonne, N. J.

Further Experiments in Electrical Heating

Data Gathered from Eight Installations in Seattle (Wash.) Residences.

For about four years the lighting department of the city of Seattle, Wash., has been investigating electric heating for the home to see just what could be done to make this form of heat cheap enough for general use.*

In the recently-issued biennial report of the Seattle Lighting Department, of which J. D. Ross is superintendent, an account is given of progress of the investigation since 1913.

Since the electric heater, states the report, of whatever type, transforms all the energy supplied to it into heat, there is nothing to be gained by attempting to raise the efficiency of the heaters themselves. The problem is to generate and distribute current at a lower price than ever before, and then to utilize the heat so that the least amount will bring the desired result, which is the maintenance of a comfortable temperature with ample ventilation in the home.

The first side of the problem, that of reducing the cost of current, may be solved in Seattle, at least in part, by the development on a large scale of the water power which is so abundant in this section of the country, and by the distribution of this power for heating by special heating circuits of higher voltage than the lighting circuits and without the expensive voltage regulators used on the lighting circuits.

DATA GATHERED FROM EIGHT INSTALLATIONS.

The other phase of the problem, the most economical use of the heat, has been very clearly defined by the experiments carried on by the department during the past four years. Data have been gathered from eight different homes equipped by the department for using electric heat in every way that appeared advantageous, both as an auxiliary and as the sole method of heating.

The first installation, at 1119 Grand Avenue, was in small five-room cottage, and consisted of open-air resistance heaters. No restriction was placed on the time or amount of current used, and the bills were paid by the owner so that the tenant was free to use as much current as he chose. Record of current was kept by recording meter, and temperature (average, maximum and minimum), were recorded every day for one year. These records are in the department files.

The consumption of current for the year was 12,360 kilowatt hours, and the maximum was 6,100 watts. Good ventilation was maintained, and the average inside temperature was kept at 68° to 70° F. The recording meter showed that the most current was used between 6:30 and 8:00 a. m. and 9:00 to 10:00 p. m., with a considerable amount between 5:00 and 9:00 p. m.

The heaviest demand, then, comes at almost the same time as the lighting peak. In order to make electric heating load an off-peak load, some heat storage is necessary. Electric heaters adapt themselves to hot water, steam, hot air or direct heating or to any combination of methods.

At 802 Thirty-third Avenue an electric water heater was installed to work in conjunction with the boiler of the hot water heating system. In the coldest weather both electric and coal heaters were used; in mild weather the electric coil alone was used, and very often the coal heater alone was used. This arrangement gave excellent satisfaction in heating the house, and the two heaters worked together without trouble.

Another method of using electric heat as an auxiliary was tried at 516 Thirtieth Avenue South. The house had a hot water heating system. The radiators in the rooms most used were equipped with individual electric heaters placed in the basement directly under them. Each heater was connected so as to permit the water in its radiator to circulate through it, and at the same time the circulation from the coal-fired boiler was not interfered with. No valves of any kind were

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* A description of the original equipment, together with a report of the tests as made up to that time were published in THE HEATING AND VENTILATING MAGAZINE for January and March, 1915.

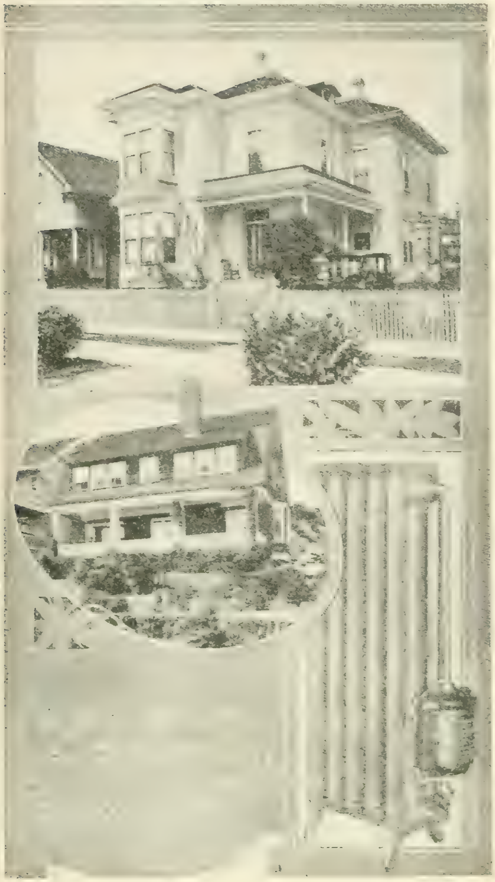

FIG. 1.

used. This arrangement is shown in the accompanying illustration. The hot water system can be operated entirely by electric current or by coal as desired, or only enough coal may be used to keep the entire house at about 60° F., and each electric heater may be used to bring its room to the temperature desired.

The first heaters used here were simply coils wound around a section of the pipe, using the pipe for a short-circuited secondary and getting the heating effect from the hysteresis and eddy currents in the iron pipe. These heaters were inferior to the resistance type used later on the same system in that their power-factor was low and it was next to impossible to eliminate the humming sound. An induction-type heater has lately been developed that has a better power factor, and is so solidly constructed that it is practically noiseless.

DATA WHERE ELECTRICITY ALONE IS USED FOR HEATING.

Experiments using electric heat as an auxiliary prove that it is most convenient, but give little information on the economy of using current alone. Data on this point were gathered from four houses using electricity alone for heating. The first of these, on Thirty-seventh Avenue, was fully equipped with heaters, heat-storage tanks, circulation pump, automatic heat control, recording wattmeters and all the apparatus that was needed for a complete test. There were nine rooms, four on the first floor and five above. The downstairs rooms were kept at 70° F. during the day and allowed to run down to 60° F. during the night. The upstairs part was maintained at about 65° F. during the day. Heat control was entirely automatic;

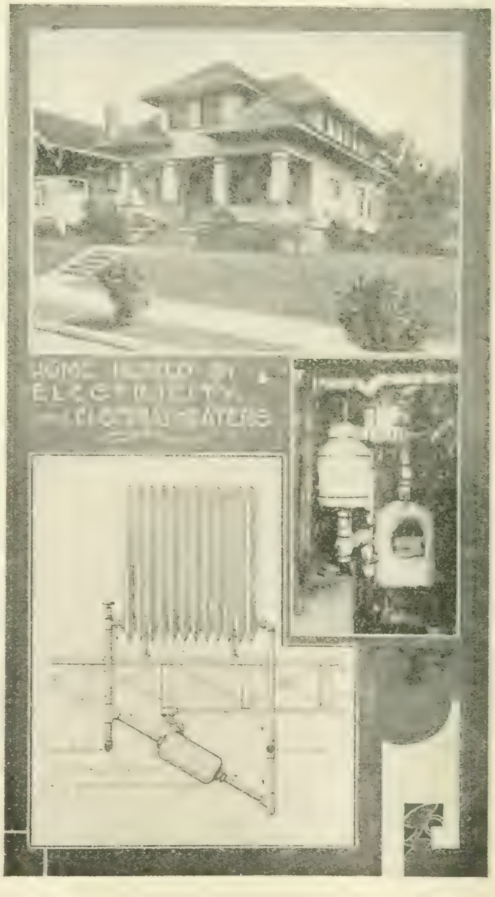

FIG. 2.

thermostats were used to keep the temperature within 2° of the desired mark, and current was turned on in the morning by timeswitch so that the house would be warm before time to arise.

The installation was made in February, 1914, and the house has been maintained at a comfortable temperature at all hours since, with practically no attention. Characteristics of the house are as follows:

First floor:

Exposed wall area	2,492 sq. ft.
Window area	180 sq. ft.
Contents	10,475 cu. ft.

Second floor:

Exposed wall area	2,357 sq. ft.
Window area	197 sq. ft.
Contents	12,275 cu. ft.

Floor surface is included in the wall area of the first floor to care for the unheated basement. Three-fourths of the ceiling is included in the wall area of the second floor.

The house is of first-class frame construction. The hot water heating system is of liberal design, with a total of 690 sq. ft. of radiation. Four 10½-kilowatt bayonet-type heaters were used, arranged in parallel with a storage tank of 500 gal. so that the water could circulate from the radiator through the heaters or through the storage tank. Time switch was used to disconnect the current entirely during the hours of lighting peak, amounting to 4½ hours in the winter months. Readings were taken daily for four months, beginning with September, 1914, of the average, maximum and minimum air temperatures, inside, upstairs and downstairs. Readings were also taken of the temperature of the circulating water, both outgoing and returning, to show the action of the storage tank. This tank has proved able to care for the hours when the current is cut off. The temperature at the end of the 4½ hours peak in December never dropped below 70° F. On the coldest days the water in the tank dropped from 190° to 104° F. during the peak, and the usual range of temperature during cold weather was from 170° to 180° F. in the tank at the time the current was turned off to 110° to 120° at the time it was turned on again. Readings on temperatures have not been made regularly since the four months' test, but occasional checks show that the temperatures maintained inside the house are practically the same as during the test. The table on Page 31 shows the average temperatures and current consumption by months.

Three other houses were equipped with the same system of electric hot water heat, and data collected for periods covering approximately two years.

	Aver. Temperatures Deg. F.				Average Difference		K. W. H.	
	Outside	Upstairs	Downstairs	Minimum Outside	Upstairs	Downstairs	To Storage Tank	Total
April, 1914	51	66	70	36	15	19	....	1,928
May “	57	67	70	43	10	13	....	968
June “	59	67	70	43	8	11	....	534
July “	64	..	..	49	..	..	....	79
August “	63	..	..	48	..	..	....	260
Sept. “	57	67	71	46	10	14	677	3,015
Oct. “	55	66	70	43	11	15	....	2,950
Nov. “	47	66	70	33	19	23	....	6,357
Dec. “	40	66	70	24	26	30	4,001	9,651
Jan., 1915	41	66	70	28	25	29	....	8,068
Feb. “	44	66	70	29	22	26	....	5,728
March “	50	66	70	34	16	20	....	4,290
April “	53	67	70	37	14	27	....	3,018
May “	56	67	71	44	11	15	....	2,954
June “	60	..	72	47	..	12	....	1,976
July “	64	..	..	52	..	..	....	284
August “	67	..	..	54	..	..	....	103
Sept. “	59	67	70	45	8	11	....	1.517
Oct. “	54	66	71	43	12	17	....	4,244
Nov. “	44	66	72	32	22	28	....	8,223
Dec. “	43	65	72	24	23	30	....	9,075
Jan., 1916	31	64	70	14	33	39	....	14,046
Feb. “	42	65	72	26	23	30	....	10,990
March “	44	66	72	32	22	28	....	8,500
April “	49	66	72	38	17	23	....	6,480

Synopsis showing the current used per year are given below. Characteristics of each house are omitted; the square feet of radiation, which was figured on the same basis as that in the Thirty-seventh Avenue house, is given in each case, and serves as a measure of the estimated heat requirements.

Address	225 37th N.	1505 36th	615 Terry	802 33d
Number of rooms	9	9	6	7
Kilowatt heaters	42	32	12	10
Square feet radiation	690	640	330	350
Consumption, first year, K.W.H.	42,850	39,320	57,210	54,930
Consumption, second year, K.W.H.	63,860	41,880	* 18,100	* 23,990
Average consumption, K.W.H.	53,355	40,600	.....	.....
Consumption per square foot of radiation per year, K.W.H.	77.3	63.4	.....	.....

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* Used as auxiliary only during second year.

EXPERIMENTS WITH OIL-FILLED RADIATORS.

During 1915 a number of heating installations were made with oil-filled, electric-heated radiators. These consist of an ordinary hot-water radiator filled with oil and having a cartridge-type heater inserted in the top. This scheme of heating has the advantage that each room has its own heater, and no piping is necessary. The radiator in each room may be turned off when not needed, although nothing is to be gained by turning off the heat where a comfortable temperature is to be maintained for most of the day, because more heat will be needed to warm the room again than was saved while it was cooling. Results obtained with the oil radiators are the same in current required and temperatures maintained as with the hot water system, with the exception that there is very little storage of heat in the oil radiators to tide over the time when current is turned off.

Data on two houses with this system follow at bottom of page.

Address	2541 11th Ave. W.	1238 E. Fir
Number of rooms	5	9
Kilowatt heaters	10½	31½
Square feet radiation	160	640
Duration of test—months	7	7
Consumption, kilowatt hours	9,777	50,960
Estimate for one year, K.W.H.	16,000	85,000
Estimate per square foot radiation, K.W. H.	100	134

Sufficient data have been collected to enable the lighting department to make a definite statement as to what can be done in any given case. So many variable factors enter into the heating of a home that each house must be studied and estimated by itself. The problems presented are almost entirely the same that have been met with regularly in heating and ventilating, except that we have kilowatt hours to deal with instead of British thermal units. With electric heat the energy is, in general, several times as expensive as in the form of coal, so that every device for saving heat is valuable.

In the ordinary building with good ventilation the heat loss is about four-fifths through the walls, while one-fifth is used to heat the air. With improved heat insulation in buildings it is conceivable that half the heat now required may do the same work, without in any way impairing ventilation, which requires about 30 cu. ft. per minute for each person. Any improvement tending to reduce the amount of heat necessary gives an advantage to electricity as compared with lower priced sources of heat.

The hot water heating system, with ample storage tank, seems to present the most advantages for use with electric heaters. This is due to the fact that the heat storage keeps a uniform temperature, for less heat is required for comfort with steady than with intermittent heat.

The tank, fitted with a small centrifugal circulating pump, will keep the house at an even temperature during the lighting peak when the current is shut off. Heating, however, cannot be permanently classed as an off-peak load. This is evident from the fact that about ten times the capacity of installation is necessary for heating a house that is used for lighting it. When one house in ten is electrically-heated, then the load curve valleys will be filled up. After that the success of heating by electricity demands cheap current at all times, which is only to be had from water power, generated in large units and distributed at comparatively high voltages. It may be feasible to serve heating customers at 400 to 500 volts three wire, which would materially reduce distribution cost.

ANALYSIS OF ELECTRIC HEATING COSTS.

The comparative cost of this method of heating is fairly well established. It is from 25% to 50% more expensive for electricity at ½ cent per kilowatt hour than for coal at $6.00 per ton. At 1 cent per kilowatt hour the electricity is two and one-half or three times as costly. These figures are borne out by theory, which says that the 10,000 B.T.U. in a pound of coal cost 0.3 cents, while in the form of current, the 3,413 B.T.U. in one kilowatt hour will cost ½ cent, making the current roughly five times as expensive. Then allowing for a furnace efficiency of 40%, which is fair for the ordinary furnace, the current would prove twice as expensive. The showing of less than one and one-half times made in the experiments is probably due to more care in the use of the heat so that less was wasted.

ADVANTAGES OF ELECTRIC HEAT.

It is very noticeable that once electric heat is installed in a home the occupants do not like to consider its removal. It delivers the home from the drudgery of building fires and handling coal and ashes, and banishes the disagreeable and injurious extremes of temperature so often tolerated now. It generates no poisonous gases and does not vitiate the air. It is, indeed, the ideal heat in everything save expense. The advantages of its use are sure to overbalance the additional expense involved for a great class of people who demand the best and are able and willing to pay for it, so that electric heat is certainly destined for a great development, even though it may never replace the more familiar forms now used.

Priming in a Heating Boiler

By H. S.

A large percentage of trouble in low pressure steam heating systems is caused by the priming of the boiler. Many steam fitters simply blow off the boiler under pressure and endeavor to cure the trouble in that way. In most cases this method is inadequate, as any grease or oil on the surface of the water will cling to the sides of the boiler as the water is being blown out through the blow-off valve. It is also surprising the number of fitters and boiler men who use soda in eliminating the foreign matter from the boiler. The soda is placed in the boiler through the safety valve connection and boiled up for a time. The water is then blown out by means of a hose. Where this is done, it is usually advisable to wash out the wet returns in the same manner.

Almost every heating boiler, particularly those which have been installed for a period of time, has an accumulation of sediment, mud, scale and other foreign matter lying at the bottom. It is difficult, in most cases, to get access to that part of the boiler in order for cleaning purposes, especially in the case of sectional cast-iron boilers having a water leg on each side. Foreign matter will collect at the bottom of these legs and, if not removed, will eventually cause a cracked section. Not only that, but foreign matter is the chief cause of boiler priming and should be removed.

It would seem advisable that the American Society of Mechanical Engineers add to its cast-iron boiler code provision for a means of access to the parts other than the regular return inlet to the boiler.

The accompanying sketch suggests one method in which such a means of access can be provided. The proposed addition to the boiler code might read as follows:

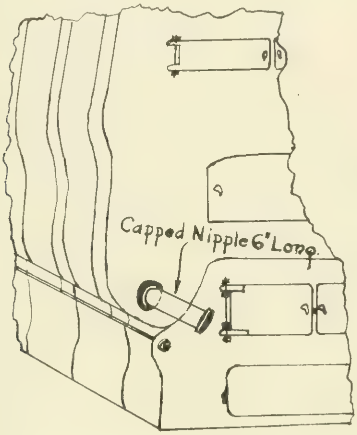


FIG. 1.—SECTION OF BOILER SHOWING PROPOSED CLEANOUT ON CAST-IRON BOILERS (NO SCALE).

"All cast-iron boilers of the double water-leg type to be provided with an opening, tapped at least 2 in. standard thread, on the outside of the bottom of each leg of the two end sections, for a cleanout. A 6-in. nipple, full size of opening, capped on the end, to be placed in aforementioned opening." A nipple, instead of a plug, should be used as it will be more accessible when the covering is placed on the boiler.

Although the foregoing is only a suggestion, the writer firmly believes that it is only a question of time before the heating trade will demand that this provision be made in all cast-iron boilers of the type mentioned.

When the boiler has been thoroughly cleaned at the bottom, it should be given what is known as a surface blow-off. The safety valve is unscrewed and in this connection is placed a bushing, usually down to ¾ in. A nipple and elbow is also used, being piped from this point to some convenient drain, such as a sewer connection or a sink. A hose can be utilized for this purpose, instead of a ¾-in. pipe, by screwing a hose coupling into the elbow and running a hose from this point. A fire should be built in the boiler after the boiler is refilled, and kept burning brightly during the entire operation. A small quantity of water should be kept running into the boiler, just enough so that it is heated up as fast as admitted. Naturally, this will depend upon how good a fire is burning in the boiler. It can readily be seen from the sketch that the hot water in the boiler will overflow through ¾-in. pipe, taking the oil and foreign matter on the surface of the water with it.

After operating the boiler in this manner for at least an hour, depending upon how soon the water becomes clear at the outlet, the fire should be slowed down and the water drawn out down to the normal water level of the boiler.

The combination of these two methods will always result in a clean boiler if the job is done in a thorough manner. Although it appears to be a long process, satisfaction and economy in operation are the results of clean water in a heating boiler.

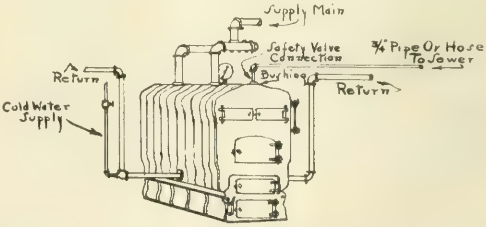


FIG. 2.—SHOWING CONNECTIONS FOR GIVING BOILER A SURFACE BLOWOFF.

DETECTING BOILER PRIMING.

There are numerous ways by which boiler priming can be detected. The common way is to notice if the water line is fluctuating. At times this is deceptive, as when the water line is only varying slightly it does not seem that the steam could be lifting water with it. More conclusive evidence is obtained by pulling the safety valve with several pounds pressure on the boiler. If water comes out with the steam it is certain that the boiler is priming.

Ordinarily, when a boiler is priming, the water line is high when starting up and drops several inches when steam is on the system. Another indication is the surging of water up and down in the supply risers and radiator connections, usually those on the end of the line. It is peculiar how boiler priming affects the heating of the radiators at different times. Almost every time the system is cooled down and started up again, different radiators fail to heat or those that have not heated will become hot.

When a boiler has clean water in it, the owner really has a heater of larger capacity, because its steam-making powers are greater. It is safe to say that there is an increase in capacity of from 20% to 25%, although this fact is not usually considered.

Manufacturers who guarantee their boilers for a certain rating should specify in their guarantee that it is based upon clean water being used.

Requirements for the Heating and Ventilation of Industrial Buildings

Measures Taken in Thirteen States to Insure Suitable Working Conditions in Factories

While the factory inspection laws of all the States provide in a general way for healthful working conditions in factories, workshops and mercantile establishments, there are apparently but thirteen States that have definite regulations on the subject. These are New York, Massachusetts, Ohio, Illinois, Arkansas, Indiana, Iowa, Pennsylvania, Michigan, Minnesota, New Jersey, Wisconsin and California.

New York.

Under the present so-called "Labor Law" in New York State all matters pertaining to the heating and ventilation of industrial buildings are in the hands of an industrial commission under whose direction the State Department of Labor is conducted. According to the law, this commission "shall have the power to make rules and regulations for and fix standards of ventilation, temperature and humidity in factories and may prescribe the special means, if any, required for removing impurities or for reducing excessive heat, and the machinery, apparatus or appliances to be used for any of said purposes, and the construction, equipment, maintenance and operation thereof, in order to effectuate the purposes of this section."

The law also provides for a bureau of inspection which includes the bureau of factory inspection.

The general terms of the law covering factory ventilation are as follows:

Section 86. 1. The person operating every factory shall provide in each workroom thereof, proper and sufficient means of ventilation by natural or mechanical means, or both, as may be necessary, and shall maintain proper and sufficient ventilation and proper degrees of temperature and humidity in every workroom thereof at all times during working hours.

2. If dust, gases, fumes, vapors, fibers or other impurities are generated or released in the course of the business carried on in any workroom of a factory, in quantities tending to injure the health of the operatives, the person operating the factory, whether as owner or lessee of the whole or a part of the building in which the same is situated, or otherwise, shall provide suction devices that shall remove said impurities from the workroom at their point of origin where practicable, by means of proper hoods connected to conduits and exhaust fans of sufficient capacity to remove such impurities, and such fans shall be kept running constantly while such impurities are being generated or released. If, owing to the nature of the manufacturing process carried on in a factory workroom, excessive heat is created therein, the person or persons operating the factory as aforesaid shall provide, maintain, use and operate such special means or appliances as may be required to reduce such excessive heat.

As regards mercantile establishments a special section (Section 168-f) states that "every mercantile establishment shall be provided with proper and sufficient means of ventilation by natural or mechanical means, or both, as may be necessary and there shall be maintained therein proper and sufficient ventilation and proper degrees of temperature and humidity at all times during working hours. The industrial board shall make rules for and fix standards of ventilation, temperature and humidity in mercantile establishments."

RULES MADE BY THE INDUSTRIAL COMMISSION.

In accordance with the foregoing sections of the "Labor Law," the Industrial Commission has promulgated a number of rules which have come to be known as the "Industrial Code." They are published, as compiled up to July 1, 1916, by the State Department of Labor, together with the law itself.

Following are the rulings bearing on the matters of heating and ventilation:

Rule 160. Ventilation. Every dressing room shall have at least one window or skylight opening directly to the outdoor air or air shaft, which shall be so constructed and maintained as to be easily opened at least one-half of its required area, except that in case a separate hospital or emergency room is provided and maintained at all times for the exclusive use of females and such room has a window or skylight opening to the outdoor air, the dressing room shall not be required to have such window or skylight.

Rule 161. Every dressing room, washroom or locker room enclosed by walls which extend to the ceiling, unless provided with windows which have an area opening directly to outdoor air, not less than one-tenth of the floor area, shall have exhaust ventilation equal to not less than six changes of air per hour at all times when such rooms are in use. A skylight shall be deemed the equivalent of a window, provided that it has fixed or movable louvres with openings of the net openable area prescribed for such window. In any such room, the commissioner may require such ventilation as may be necessary.

Rule 162. Heating and Illumination. Every dressing room shall be heated to a temperature of not less than 58° F., and shall be so lighted that all parts of the rooms are easily visible. If daylight is not sufficient for this purpose, artificial illumination shall be maintained at all times when the room is in use.

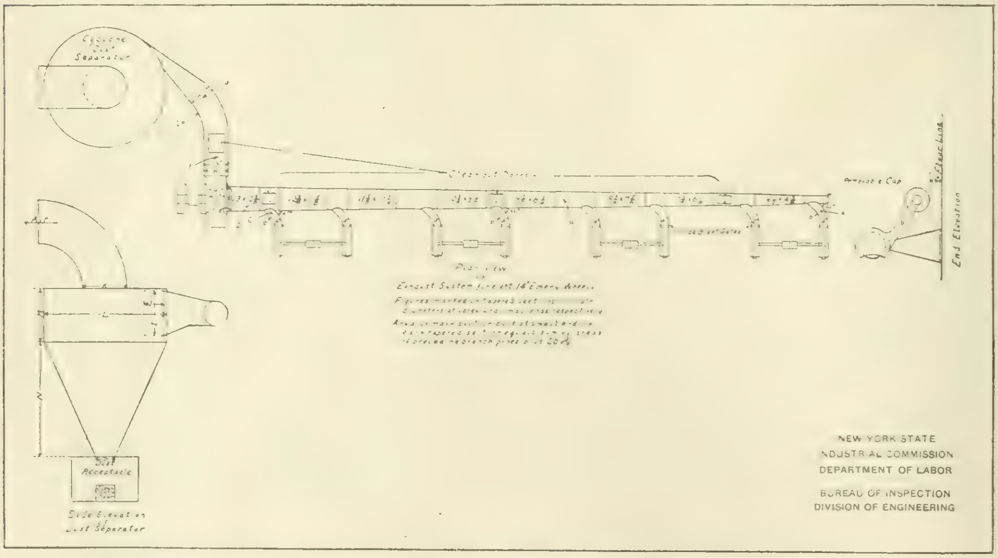
Rule 556 refers to the removal of smoke, steam, gases and dust from foundries. It is specified that "where smoke, steam, gases or dust arising from any part of the operations of the foundry are dangerous to health and where a natural circulation of air does not carry off such smoke, steam, gases or dust, there shall be installed and operated hoods, ventilators, fans or other mechanical means of ventilation approved by the commissioner of labor."

Rules 700-716 gives the appliances to be applied for the removal of dust, gases and fumes from grinding, polishing and buffing wheels, including the sizes of branch pipes, size of main pipes and fan inlets and outlets suction, arrangement and construction of pipes, etc.

Rule 718 provides for the removal of fumes, vapors and gases emitted or created in connection with some twenty special processes of manufacture.

Rule 721 gives similar arrangements for the removal of lead dusts and fumes in the manufacture or use of white lead, red lead, litharge, sugar of lead, arsenate of lead, lead chromate, lead sulphate, lead nitrate or fluosilicate, or in the manufacture of pottery, tiles or porcelain enameled sanitary ware, including the corroding or oxidizing of lead, and the crushing, mixing, sifting, grinding and packing of all lead salts or other compounds.

"Recommendations for the size of the cyclone separator or dust collected," states



TYPICAL LAYOUT FOR EIGHT 14-IN. EMERY WHEEL EXHAUST SYSTEM.
(Reference and Dimension Letters are Merely for Convenience of Inspectors.)

the code, "are hard to give, as the separator must be proportioned to suit operating conditions, light dusts requiring a larger separator than heavy dusts. The following table, reproduced from the catalogue of a prominent separator manufacturer, gives dimensions of separators stated to be suitable for metallic dusts and wood shavings. A separator should be selected the area of whose inlet is at least as large as the area of the discharge pipe from the fan. For light buffing dusts, lint, etc., the air outlet from the top of the separator should be so large that the velocity of discharge will not exceed 300 to 480 ft. per minute; a separator should be selected of which the other dimensions are proportionate. The air outlet should be provided with a proper canopy or elbow to exclude the weather, but should be otherwise unobstructed. There should be ample clearance under the separator for the accumulation or storage of the dust which should never be allowed to pile up as high as the bottom of the separator.

"To give a sample illustration, the appended drawing shows an exhaust system laid out in conformity with these specifications for eight 14-in. emery wheels. For eight 14-in. buffing wheels, the branch pipes would have to be not less than 4½ in. in diameter, and the increased size of the main suction duct and the fan determined in accordance with Rule 703. The main discharge pipe and the cyclone separator should be considerably larger for buffing wheels than for emery wheels.

DUST SEPARATORS

Diameter of fan outlet in inches	Area of fan outlet in square inches	OPENINGS IN SEPARATOR					DIMENSIONS OF SEPARATOR			Shipping weight, lbs.
		Size of inlet in inches	Area of inlet in square in.	Diameter of air outlet in inches	Area of air outlet in square in.	Diameter of dust outlet in inches	Outside diameter of cylinder in inches	Height of cylinder in in.	Length of cone in in.	
5	29	2½ x 9	23	8½	56	3	29½	14	26½	70
6	28	3 x 10½	32	10	78	4	35½	15½	32½	100
7	38	3½ x 13	47	13	132	6	41½	18½	37½	140
or	or									
8	50									
9	63	4½ x 16	72	15	176	6	47½	21	43½	175
10	78	5 x 18	90	17	227	6	53½	23	50	245
11	95	5½ x 21	115	20	314	10	59½	26	56	315
or	or									
12	113									
13	133	6½ x 24	156	23½	433	10	65½	29	61½	395
or	or									
14	154									
15	177	7 x 27	189	26	531	10	71½	32	67½	490
16	201	8 x 30	240	28	615	10	77½	35	72½	575
or	or									
17	227									
18	254	8½ x 32	272	31	754	10	83½	38	77½	715
19	283	9 x 35	315	33	855	10	89½	41	82½	875
or	or									
20	314									
21	346	9 x 40	360	36	1,017	10	93½	46	85½	930
22	380	10 x 41	410	39	1,194	10	97½	47	89	1,000
23	415	10½ x 43	451	41	1,320	11	101½	49	93	1,095
or	or									
24	452									
25	491	11 x 45	495	44	1,520	11	105½	51	97	1,455
26	531	11 x 48	528	46	1,662	12	109½	54	99½	1,600
27	572	11 x 51	561	49	1,885	12	113½	57	103½	1,700
28	621	11½ x 54	621	52	2,123	12	117½	60	109½	1,855
29	660	12 x 57	684	55	2,375	12	121½	63	111½	2,035
30	707	12 x 60	720	58	2,642	12	125½	66	115½	2,155
31	754	12½ x 63	807	61	2,922	13	129½	69	118½	2,250
or	or									
32	804									
33	855	13 x 66	858	64	3,217	13	133½	72	122½	2,420
34	908	13½ x 69	932	67	3,525	13	137½	75	126½	2,555
35	962	14 x 72	1,008	70	3,848	14	141½	78	129½	2,745
36	1,017	14½ x 75	1,087	73	4,185	14	145½	81	133½	2,900
or	or									
37	1,075									
38	1,134	15 x 78	1,170	76	4,536	14	149½	84	137½	3,065
39	1,194	15½ x 81	1,255	79	4,901	14	153½	87	141½	3,235
or	or									
40	1,256									
41	1,320	16 x 84	1,344	82	5,281	14	157½	90	145½	3,39

"The following table gives the diameter in inches of the main suction duct at any point for any number of uniform-size branch pipes when the area of the main at any point is made equal to the combined areas of the branch pipes preceding that point plus 20%, the minimum required by these specifications."

Violations of the provisions of the labor law are punished by fines running from $20.00 to $50.00 for the first offense. Second and third offences incur penalties running up to $250.00 and imprisonment for 60 days.

Number of branch pipes	Diameter of branch pipes in inches								
	3	3½	4	4½	5	5½	6	6½	7
	Area of each branch pipe in square inches								
	7 07	9 62	12 566	15.9	19 635	23.758	28.274	33.183	38.485
	Area of each branch pipe plus 20 per cent (square inches)								
	8 484	11 544	15.08	19 08	23.562	28.51	33.93	39 82	46.182
1	3⅜	3⅞	4⅜	5	5½	6	6⅝	7⅛	7¾
2	4¾	5½	6¼	7	7¾	8⅝	9¼	10⅛	10⅞
3	5¾	6⅝	7⅝	8⅝	9½	10½	11½	12⅛	13¼
4	6⅝	7¾	8¾	9⅞	11	12⅛	13⅛	14¼	15⅜
5	7⅜	8⅝	9⅞	11	12¼	13½	14¾	16	17⅛
6	8⅛	9½	10¾	12⅛	13½	14¾	16⅛	17½	18¾
7	8¾	10¼	11⅝	13⅛	14½	16	17½	18⅞	20¼
8	9⅜	10⅞	12⅜	14	15½	17⅛	18⅝	20⅛	21¾
9	9⅞	11½	13⅛	14⅞	16½	18⅛	19¾	21⅜	23
10	10½	12⅛	13⅞	15⅝	17⅜	19⅛	20¾	22½	24¼
11	11	12¾	14⅝	16⅜	18¼	20	21⅞	23⅝	25½
12	11½	13⅜	15¼	17⅛	19	20⅞	22¼	24¾	26⅝
13	11⅞	13⅞	15⅞	17⅞	19¾	21¾	23¼	25¾	27¾
14	12⅜	14⅜	16½	18½	20½	22⅝	24⅝	26¾	28¾
15	12¾	14⅞	17	19⅛	21¼	23⅜	25½	27⅝	29¾
16	13¼	15⅜	17⅝	19¾	22	24⅛	26⅜	28½	30¾
17	13⅝	15⅞	18⅛	20⅜	22⅝	24⅞	27⅛	29⅜	31⅝
18	14	16⅜	18⅝	21	23¼	25⅝	27⅞	30¼	32⅝
19	14⅜	16¾	19⅛	21½	23⅞	26¼	28¾	31⅛	33½
20	14¾	17⅛	19⅝	22⅛	24½	27	29½	31⅞	34⅜
21	15⅛	17⅝	20⅛	22⅝	25⅛	27⅝	30⅛	32¾	35⅛
22	15½	18	20⅝	23⅛	25¾	28⅜	30⅞	33½	36
23	15¾	18½	21⅛	23¾	26⅜	29	31½	34¼	36¾
24	16⅛	18⅞	21½	24¼	26⅞	29⅝	32¼	34⅞	37⅝
25	16½	19¼	22	24¾	27½	30⅛	32⅞	35⅝	38⅜
26	16¾	19⅝	22⅜	25⅛	28	30¾	33½	36⅜	39⅛
27	17⅛	20	22⅞	25⅝	28½	31⅜	34⅛	37	39⅞
28	17½	20⅜	23¼	26⅛	29	32	34¾	37¾	40⅝
29	17¾	20¾	23⅝	26⅝	29½	32½	35¼	38⅛	41⅜
30	18	21	24	27	30	33	36	39	42

PRACTICE OF THE NEW YORK STATE INDUSTRIAL COMMISSION.

"It is a customary practice in the Department when we find it necessary to install exhaust systems for the purpose of carrying away dust and gases, etc., to issue orders and set a time when compliance is necessary."—JAMES L. GERNON, First Deputy Commissioner, Bureau of Inspection.

Massachusetts.

The Massachusetts law went into effect November 1, 1913 (Acts of 1913, Chapter 655). This law is enforced by the Building Inspection Department of the District Police and reads as follows:

"Section 15. No building which is designed to be used, in whole or in part, and no building in which alterations shall be made for the purpose of using, or continuing its use, in whole or in part, as a public building, public or private institution, schoolhouse, church, theatre, special hall, public hall, miscellaneous hall, place of assemblage or place of public resort, or as a factory, workshop or mercantile or other establishment and to have accommodations for ten or more employees, and no building more than two stories in height, designed to be used above the second story, in whole or in part * * * shall be erected, and no alteration shall be made therein, until a copy of the plans and specifications thereof has been deposited with the supervisor of plans of the building inspection department of the district police by the person causing its erection or alteration, or by the architect thereof. Such plans and specifications shall include those for heating, ventilating and sanitation, as the supervisor of the plans may require."

A fine of from $500.00 to $1,000.00 is provided for anyone who violates the provision of this requirement.

PRACTICE OF THE MASSACHUSETTS BUILDING INSPECTION DEPARTMENT OF THE DISTRICT POLICE.

"This Department has no regulations relating to the heating and ventilating of factory buildings, but such work is taken up only in special cases by the State Board of Labor and Industries, and applies to factories where buffing and grinding wheels, etc., are used; and to the ventilation of sanitaries in factory buildings. The matter of heating and ventilating factories has not been compulsory except in special cases in certain factories on account of the processes used in manufacturing and also on account of the number of employees distributed in rooms to operate the machines, etc. The Massachusetts law provides that, if so directed, plans for heating and ventilation shall be filed with the plan of the building thereof.—J. J. CAREY, Deputy Chief.

Ohio.

The Ohio laws governing factory and building inspection states in Section 989 that each district inspector of workshops and factories assigned to a district for the inspection of shops and factories therein, shall carefully inspect the sanitary conditions, system of sewerage * * * system of heating, lighting and ventilating rooms where persons are employed at labor," etc.

Under the power conferred by Section 996, if he finds "that the heating, lighting, ventilation or sanitary arrangements of a shop or factory are injurious to the health of persons employed or residing therein, * * * he shall notify the owner, proprietor or agent of such shop or factory or building by personally serving a notice in writing or mailing it to his last known address, to make the necessary alterations or additions. Said notice shall describe the alterations and additions which shall be installed therein and the time in which each alteration or addition therein required shall be made and each appliance installed."

Penalties are provided running from $50.00 to $100.00 per day after the expiration of the time limit set by the inspector for making required changes.

The term "shops and factories" includes the following: Manufacturing, mechanical, electrical, mercantile, art and laundering establishments, printing, telegraph and telephone offices, railroad depots, hotels, memorial buildings, tenement and department (apartment) houses.

In connection with the safe-guarding of machinery, owners and operators of shops and factories are required to make suitable provision for emery wheels and for metal and wood-working machinery generally. The various requirements and the methods prescribed for fulfilling them are given in detail in the code.

The penalty for failing to comply with the provisions of the code within 30 days vary from $100.00 to $300.00 for each offense.

Additional provisions are included (Section 6330-2) covering especially dangerous works or processes, such as the manufacture of white lead, red lead, litharge, sugar of lead, arsenate of lead, lead chromate, lead sulphate, lead nitrate, or fluo-silicate. In such cases "every employer shall without cost to the employees, provide * * * devices, means and methods for the protection of his employees who, while engaged in any work or process included in section 2 are exposed to lead dusts, lead fumes or lead solutions:

"(*a*) Working rooms, hoods and air exhausts for the protection of employees engaged in any work or process which produces lead dusts or lead fumes. The employer shall provide and maintain work rooms adequately lighted and ventilated, and so arranged that there is a continuous and sufficient change of air, and all such rooms shall be fully ventilated and separated by partition walls from all departments in which the work or process is of a non-dusty character; and all such rooms shall be provided with floor, permitting an easy removal of dust by wet methods or vacuum cleaning, and all such floors shall be so cleaned daily.

"Every work or process referred to (given above) including the corroding or oxidizing of lead, and the crushing, mixing, sifting, graining and packing of all lead salts or other compounds shall be so conducted and such adequate devices provided and maintained by the employer as to protect the employee, as far as possible from contact with lead dust or lead fumes. Every kettle, vessel, receptacle or furnace in which lead in any form referred to is being melted or treated, and any place where the contents of such kettles, receptacles or furnaces are discharged, shall be provided with a hood connected with an efficient air exhaust; all vessels or containers in which dry lead in any chemical form or combination referred to, is being conveyed from one place to another within the factory, shall be equipped, at the places where the same are filled or discharged, with hoods having connection with an efficient air-exhaust; and all hoppers, chutes, conveyors, elevators, separators, vents from separators, dumps, pulverizers, chasers, dry pans, or other apparatus for drying pulp lead, dry-pans dump, and all barrel packers and cars of other receptacles into which corrosions are at the time emptied, shall be connected to an efficient dust-collecting system; such system to be regulated by the discharge of air from a fan, pump, or other apparatus, either through a cloth dust-collector having an area of not less than ½ sq. ft. of cloth to every cubic foot of air passing through it per minute, the dust collector to be placed in a separate room which no employee shall be required or allowed to enter, except for essential repairs, while the works are in operation; or such other apparatus as will efficiently remove the lead dusts from the air before it is discharged into the outer air."

In Cleveland, Ohio, a new building code became effective October 14, 1913. It is known as Ordinance No. 29,798. This code has the following relating to "factories and workshops:"

"Every building, room or part thereof hereafter erected for, or converted to use as a factory or workshop in which there shall be less than 20 sq. ft. of floor space for each employee or occupant, shall have in operation, while occupied, a mechanical system of ventilation so designed and installed as to provide at least six complete air changes per hour.

"Unless natural ventilation is provided as required by the ordinances of the City of Cleveland, and maintained while occupied, every factory in which there is more than 20 sq. ft. of floor space for each employee or occupant, shall have in operation, while occupied, a system of ventilation so designed and installed as to provide at least four complete air changes per hour."

PRACTICE OF THE INDUSTRIAL COMMISSION OF OHIO.

"The specific requirements for the construction of factories (Title 7) has not yet been adopted by this Department. The heating systems approved in this Department for factory construction are either a direct steam or blast system, or may be a furnace blast system. The only ventilation required in factories is that which is obtained through the windows. The new, modern type of factory construction has considerable glass area for light. Either double-hung windows, or pivoted sash are used, and we find the ventilation in these cases very satisfactory. However, we find in some of the old factory buildings a very limited amount of windows and the air in these cases is very bad. Then it is necessary for the Chief to exercise his authority by ordering some type of ventilation to be installed."—George H. Hamilton, Chief Deputy, Department of Inspection.

Illinois.

The Illinois law regarding the heating and ventilation of factory buildings is probably the most explicit of any so far enacted in this country. It is entitled, "An act to provide for the health, safety and comfort of employees in factories, mercantile establishments, mills and workshops in Illinois and to provide for the enforcement thereof." (Re-enacted and approved June 29, 1915. In force July 1, 1915.)

Section 10 reads: "In every factory, mercantile establishment, mill or workshop, where one or more persons are employed, adequate measures shall be taken for securing and maintaining a reasonable and, as far as possible, equable temperature, consistent with the reasonable requirements of the manufacturing process. No unnecessary humidity which will jeopardize the health of employees shall be permitted."

The meat of the law is in Section 11 which reads: "In every room or apartment of any factory, mercantile establishment, mill or workshop, where one or more persons are employed, at least 500 cu. ft. of air space shall be provided for each and every person employed therein, and fresh air, to the amount specified in this act, shall be supplied in such a manner as not to create injurious drafts, nor cause the temperature of any such room or apartment to fall materially below the average temperature maintained: Provided, where lights are used which do not consume oxygen, 250 cu. ft. of air space shall be deemed sufficient. All rooms or apartments of any factory, mercantile establishment, mill or workshop, having at least 2,000 cu. ft. of air space for each and every person employed in each room or apartment, and having outside windows and doors whose area, shall not be required to have artificial means of ventilation; but all such rooms or apartments shall be properly aired before beginning work for the day and during the meal hours. All such rooms, or apartments, having less than 2,000 cu. ft. of air space, but more than 500 cu. ft. of air space, for each and every person employed therein, and which have outside windows, and doors whose area is at least one-eighth of the floor area, shall be provided with artificial means of ventilation, which shall be in operation when the outside temperature requires the windows to be kept closed, and which shall supply during each working hour at least 1,500 cu. ft. of fresh air for each and every person employed therein. All such rooms or apartments, having less than 500 cu. ft. of air space for each and every person employed therein, all rooms or apartments having no outside windows or doors, and all rooms or apartments having less than 2,000 cu. ft. of air space for each and every person employed therein, and in which the outside window and door area is less than one-eighth of the floor area, shall be provided with artificial means of ventilation, which will supply during each working hour throughout the year, at least, 1,800 cu. ft. of fresh air for each and every person employed therein: Provided, that the provisions of the preceding portions of this section shall not apply to storage rooms or vaults: And, provided, further, that the preceding portions of this section shall not apply to those rooms or apartments in which manufacturing processes are carried on which from their peculiar nature would be materially interfered with by the provisions of this section. No part of the fresh air supply required by this section shall be taken from any cellar or basement.

"The following terms of this section shall be interpreted to mean: the air space available for each person is the total interior volume of a room, expressed in cubic feet, without any deductions for machinery contained therein, divided by the average number of persons employed therein.

"Outside windows and doors are those connecting directly with the outside air; the window and door area is the total area of the windows and doors of all outside openings: and the floor area is the total floor area of each room."

"Sec. 12. All factories, mercantile establishments, mills or workshops shall be kept free from gas or effluvia arising from any sewer, drain, privy or other nuisance on the premises. All poisonous or noxious fumes or gases arising from any process, and all dust of a character injurious to the health of the persons employed, which is created in the course of a manufacturing process, within such factory, mill or workshop, shall be removed, as far as practicable, by either ventilating or exhaust devices."

Section 20 covers the ventilation of toilet rooms to the effect that, "where practicable, they shall direct ventilation with the outside air; where it is impracticable (to so locate them), they shall be placed in an enclosure * * * and separately ventilated.

Section 25 * * * When general changes relative to the location and spacing of machinery or to ventilation have been made and such changes comply with the provisions of this act, such arrangements, conditions remaining the same, shall not be disturbed by any requirement of the chief state factory inspector or his deputies within the period of twelve months.

Fines for failure to comply with the foregoing provisions run from $10.00 to $50.00 for the first offense, and from $25.00 to $200.00 for the second or subsequent offense.

All buildings and rooms occupied by butterine and ice cream manufacturers must be provided with air shafts, windows and ventilating pipes sufficient to insure ventilation. The factory inspector directs such installations. The law also provides for blowers in workshops where emery wheels or emery belts of any description are used.

PRACTICE OF THE ILLINOIS DEPARTMENT OF FACTORY INSPECTION

"We have no specific requirements as to heating, but you will note that Section 11 provides that artificial ventilation, when required, must be applied in a manner which will not cause injurious drafts or materially alter the temperature of the room."—OSCAR F. NELSON, Chief.

Arkansas.

Factory ventilation requirements in Arkansas are contained in the Workmen's Compensation Law which reads as follows:

Section 5. The commissioner, as State factory inspector (or deputy State factory inspector) shall have power to enter any factory or mill, workshop, private works or State institution which have shops or factories, when the same are open or in operation, for the purpose of gathering facts and statistics such as are contemplated by this act, and to examine into the methods of protection from danger to employees and the sanitary conditions in and around such buildings and places; and to make a record thereof of such inspection. If the commissioner as State factory inspector (or deputy State factory inspector) shall find upon such inspection that the heating, lighting, ventilation or other sanitary arrangement of any workshop or factories is such as to be injurious to the health of the persons employed or residing therein * * * he shall notify, in writing, the owner, proprietor or agent of such workshops or factories to make, within thirty days, the alterations or additions by him deemed necessary for the safety and protection of the employees; and if such alterations or additions are not made within thirty days from the date of such written notice, or within such time, as said alterations or additions can be made with proper diligence upon the part of such proprietors, owners or agents, said proprietors, owners or agents so notified shall be deemed guilty of a misdemeanor, and upon complaint of a commissioner as State factory inspector before a court of competent jurisdiction, and upon conviction thereof, shall be fined in a sum not less than $25.00 nor more than $200.00, or by imprisonment not more than ninety days, or by both such fine and imprisonment.

Section 6. The following expressions used in this act shall have the following meanings:

The expression "person" means an individual corporation, partnership or association.

The expression "children" means minor persons under the age of fourteen years.

The expression "minor" means a male person under the age of twenty-one, or a female under the age of eighteen years.

The expression "women" means female persons of eighteen years of age and upward.

The expression "factory" means any premises where steam, water, or other mechanical power is used in aid of any manufacturing process there carried on.

The expression "workshop" means any premises, room, or place, not being a factory as above defined, wherein any manual labor is exercised by way of trade, or for the purpose of gain in or incidental to any process of making, altering, repairing, ornamenting, finishing or adapting for sale any article or part of an article, and to which or over which premises, room or place the employer of the person or persons working therein has the right of access or control; provided, however, that the exercise of manual labor in a private house, or a private room by the family dwelling therein, or by any of them, or in case a majority of persons therein employed are members of such family, shall not of itself constitute such house or room a workshop within this definition.

The aforesaid expressions shall have the meanings above defined for them respectively in all laws of this State relating to the employment of labor, unless a different meaning is plainly required by the context.

Indiana.

The Indiana Law on ventilation of industrial buildings states that "there shall be sufficient means of ventilation provided in each workroom of every manufacturing or mercantile establishment, laundry, renovating works, bakery, or printing office within the state, and the chief inspector shall notify the owner in writing to provide or cause to be provided ample and proper means of ventilation for such workroom."

Owners or agents are to be prosecuted for non-compliance with the law within twenty days. The law also provides for exhaust fans for carrying off dust from emery wheels, grindstones and dust creating machinery, the size of mains, etc., being specified.

Iowa.

In Iowa there is a law relating to exhausting systems for emery wheels or emery belts of any description, or tumbling barrels used for rumbling or polishing castings. "Any factory, workshop, print shop," the law adds, "or other place where molten metal or other material which gives off deleterious gases or fumes is kept or used, shall be equipped with pipes or flues so arranged as to give easy escape to such gases or fumes into the open air, or provided with other adequate ventilators."

Pennsylvania.

The Pennsylvania requirements regarding blowers and exhausters for use with grinding and polishing machinery, are enforced by the Industrial Board of the state. This board publishes a set of directions covering suction test and piping, and other features.

Michigan.

In Michigan, a law provides for exhaust systems for carrying off dust from emery wheels and grindstones and dust creating machinery "wherever deemed necessary by the factory inspector." There is also a rule covering the ventilation of foundries and detailed directions are given for complying with the law.

Minnesota.

The Minnesota law after specifying that each employee must have not less than 400 cu. ft. of air space unless reduced by a special order of the Commissioner of Labor, goes on to provide for "sufficient means of ventilation" where excessive heat is created, or if steam, gases, vapors, dust or other impurities that might be injurious to health, are generated.

New Jersey.

The New Jersey law provides for exhaust systems in workshops where emery wheels or emery belts of any description are used. Regarding sizes of rooms, it is specified that not less than 250 cu. ft. of air space shall be provided for each employee, between 6 a. m. and 6 p. m., and not less than 400 cu. ft. of air space between 6 p. m. and 6 a. m. Regarding the ventilation of the factory itself, the law, as amended by act approved February 26th, 1912, reads as follows:

"The owner, agent or lessee of a place coming under the provisions of this act shall provide, in each workroom thereof, proper and sufficient means of ventilation, and shall maintain proper and sufficient ventilation; if excessive heat be created or if steam, gases, vapors, dust or other impurities that may be injurious to health be generated in the course of the manufacturing process carried on therein, the room shall be ventilated in such a manner as to render them harmless, so far as is practicable; in case of failure, the Commissioner of Labor shall order such ventilation to be provided."

Compliance with the law must be made within twenty days on penalty of $10.00 fine for each day beyond that limit. Exhaust fans must also be provided in foundries where smoke, steam, dust or noxious gases are not promptly carried off by the general ventilation. The requirements for mercantile establishments state that "the owner, agent or lessee of a place coming under the provision of this act, or employer, shall provide in each mercantile establishment proper and sufficient means of ventilation; in case of failure, the commissioner shall order such ventilation to be provided."

A similar penalty clause is added as for workrooms.

Wisconsin.

The requirements in Wisconsin are in the form of general orders of the State Industrial Commission. Order No. 2,000 deals with hoods for grinding, buffing and polishing wheels.

Orders No. 2,001-2,006 deal with suction pipes for hoods, amount of suction required, position of main pipe and dust collector.

Orders No. 2,007 to 2,010, cover belts, drums, rolls and disks for grinding, buffing, polishing or sanding; sand blasts and tumbling barrels.

Orders No. 2,011 to 2,013 deal with machines which create dust, vats and tanks which emit fumes, and furnaces and forges.

Order No. 2,014 provides for the ventilation of foundries, forgeshops and roundhouses.

Order No. 2,015 covers workrooms where there is less than 900 and more than 300 cu. ft. of air space per person. All such rooms in which there is no smoke, gas, fumes, dust, vapors or fires consuming oxygen "must be provided with a ventilating system which will furnish 1,800 cu. ft. of fresh air per hour to each person. Additional ventilation must be provided where there are lights or fires in such rooms."

Other rooms containing 900 cu. ft. of air space per employee "must be provided with a ventilating system which will change the air in the room not less than twice each hour. Such system must be so designed as not to produce injurious drafts or reduce the temperatures materially below the average temperature maintained."

Order No. 2,205 reads: "In each toilet room heretofore installed, and which is so located that it is impossible to secure light and air directly from the outside, a flue or mechanical ventilating system must be installed which will provide adequate ventilation.

"In Wisconsin the Industrial Commission has power to issue orders for any changes in existing and new systems. The factory head may make an appeal from the agents ruling and if the majority of the commission decides against him, he must make the required changes. This decision can only be reached after the majority of the commission have visited his factory personally and examined the existing conditions."

California.

The factory ventilation law in California provides that "Every factory or workshop in which five or more persons are employed shall be so ventilated while work is carried on therein that the air shall not become so exhausted as to be injurious to the health of the persons employed therein, and shall also be so ventilated as to render harmless, as far as practicable, all the gases, vapors, dust, or other impurities generated in the course of the manufacturing process or handicraft carried on therein, that may be injurious to health."

The law also provides for the removal of dust, filaments or injurious gases by means of exhaust fans or blowers together with the usual system of pipes and hoods.

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EFFORTS on the part of heating engineers, both individually and collectively, to come to an agreement regarding a uniform set of heat loss coefficients, have been so futile that it is no wonder the younger men in the profession are bewildered by the conflicting data on the subject. And this confusion is only intensified when reference is made to the various "standard" works on the subject, for there the variance is equally marked. Even among the more experienced engineers there must be at times some misgivings when it is considered that their calculations may vary, as was illustrated in a recent notable instance, over 50% for the same interior.

This being the situation, there is considerable point to the suggestion made by a correspondent that there is a "glaring need of a board or society to decide once and for all, or until such time as tests will prove otherwise," such points as those mentioned. "If this cannot be done," continues our correspondent, "then let one of the leading magazines representing the heating profession step in and lead the way, so to speak. Then, may I ask, what magazine is in a better position to do this than THE HEATING AND VENTILATING MAGAZINE?"

Aside from the compliment contained in our correspondent's suggestion, which is fully appreciated, there is a challenge here that cannot be ignored. After giving the matter careful consideration, it strikes us as possible to promulgate a set of factors that may be considered as tentative standards, at least, with the idea of arousing discussion and, at length, getting them down to a basis that will meet with general approval.

With this idea in mind, we have undertaken to publish in serial form what, we hope, will become the nucleus of a heating engineers' data book. It is our intention to present these data in suitable form for separate binding and, after sufficient discussion, to add revision sheets where necessary.

If we shall have the co-operation of our readers in this matter, a reliable data code will develop that will represent the opinions of no one journal or engineer, but the collective opinion of the profession.

The first of these data sheets will appear in the February issue.

◆

AMONG the suggestions for heating symbols and abbreviations, made at the recent meeting of the British heating engineers, is one which, we should think, would be especially welcome to American engineers. In place of the British thermal unit, or B.T.U., it is proposed to use the word "Therms" and to indicate it by the Greek letter, theta (Θ), with this difference, that the letter would have a bar extended beyond the vertical lines. The definition would remain the same as at present.

The Consulting Engineer

"The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

CONDUCTED BY IRA N. EVANS

70—Operating Steam-Jacketed Kettles.

QUESTION: I have a number of steam jacketed kettles which I wish to operate from a boiler carrying 90 lbs. of steam and return the condensation to the boiler. The jackets of the kettles are built for a pressure of 150 lbs. The pressure will have to be varied in the jackets to obtain the temperature desired for different classes of cooking. How can this be done?

ANSWER: The proper method of handling the condensation for these kettles is by a return trap. The trap is a tank connected with the receiver, as shown in the accompanying sketch, in such a manner that the pressure is relieved, and the pressure on the apparatus forces the condensation into the trap or tank. By means of a float or by the weight of water in the tank tilting it, the steam from the boiler is turned into the tank on top of the condensation in the trap, through pipe C. This equalizes the boiler pressure and causes the water to flow back through the return pipe, as shown. While the trap is connected to the boiler, a check valve D closes and prevents the pressure from entering the system of returns.

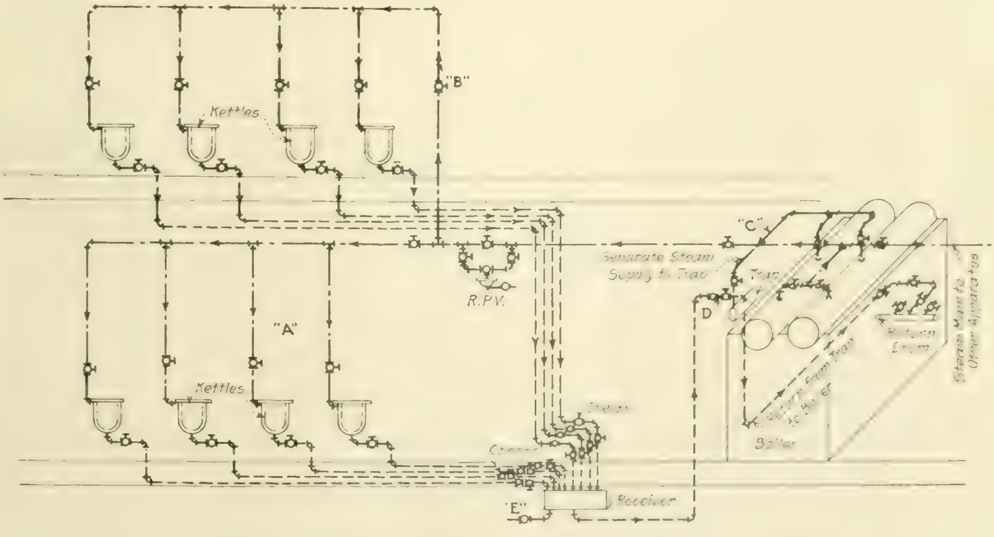
When the trap is emptied of water the float rises or the tank moves, depending on the type used, this action being due to the lessened weight automatically closing the steam valve in the pipe C. At the same time an air valve opens and relieves the pressure in the tank. Check D now opens and takes another charge of water from the system. This operation is repeated, the tilting of the trap automatically connecting the tank with the system of returns and then to the boiler.

As above stated, valve C, or the steam-equalizing pipe from the boiler, is opened or closed by a float or by the tank itself as it is filled and emptied.

In case there is no quick relief for the steam pressure in the tank after emptying, a period of time has to elapse until the radiation condenses the residual steam and reduces the pressure.

All kettles should be connected as shown and separate returns, with checks, run to the receiver. R.P.V. is a pressure reducing valve which can be operated at any pressure below that on the boiler that will raise the water from the receiver to the top of the boiler, where the trap is placed.

The kettles are shown in two series, A and B. Lower pressures may be carried on the upper set equal to the difference in level of



TYPICAL SCHEME FOR OPERATING STEAM-JACKETED KETTLES.

kettles A and B, but no more. If higher pressures are carried on series B than on Series A, the checks will close on A and they will not return. The receiving tank should be at least 3 ft. below the lowest point of kettles A.

Care must be taken to have a separate steam connection (c) for the trap, or if taken off any other line, the pressure may be reduced sufficiently over that on the boiler proper that the system will not return.

Checks and valves should all be placed as shown. Considerable difference in pressures can be carried in the different kettles of Series B by throttling, equal to height of the column of water in the drop legs on each return, as, with the checks, the various differences in pressure will be equalized. This is not true of kettle A, as there is less fall.

Care should also be taken, if possible, to return the trap to boiler through a separate line, with checks and hand valves, as when connected to other pipes, varying pressures may interfere with the proper operation of the trap. The writer used this system in a large hotel kitchen in Boston and it gave perfect satisfaction and was fool-proof. There is no more economical method of accomplishing this operation as it does away entirely with drain traps and all circuits are sealed.

E is a free blow provided, to be connected to sewer or feed water heater through a drain trap, in case anything should happen, such as the return trap failing to work, while the kettles had to be operated. If the drain trap is placed at a fairly good height above the receiver, it can be left open permanently and if the water gets above the inlet to the drain trap, it will relieve the receiver. This is apt to be bad for when the condensation has to be blown away without the drain trap, the extra work and steam required will force the operating hands to fix the return trap, while if it is ready for service or open all the time, it may go into operation when the return trap fails to work and not be disturbed for months, thus wasting a considerable amount of heat and hot water.

The writer sometimes purposely arranges apparatus such as the return trap mentioned so that the system will be difficult to operate if the return trap fails to work, thus insuring prompt attention and repair when necessary.

71—Function of Tempering and Heating Coils.

QUESTION: Please tell me in your magazine what is the use of tempering coils with a fan system of heating. Why are two sets of coils used with a fan system?

ANSWER: Tempering coils are used to raise the temperature of all outdoor air as soon as it is admitted to the building to 70° F., or the room temperature, for the following reasons:

1. All the air admitted has to be raised to this temperature at some point and it is more economical, both from an operating and installation standpoint, to heat it all in one stack at a central point.

2. If the air were passed cold through ducts to individual stacks the same amount of work would have to be done, yet the cold air would chill the building and the individual stacks might freeze in extreme weather. Some years ago the old New York County Court House, in New York, was heated without a tempering coil near the air inlet and nearly all of the individual coils under the flues froze or burst at one time or another. A tempering stack, which was turned on all the time to give the initial rise to the outdoor air, remedied this condition, when the system was remodeled.

3. As different rooms need different amounts of heat and some are apt to heat more easily than others, it is much simpler to raise the air to a common temperature, say, 70° F., and then pass it through a reheating stack, automatically controlled for each room. When the room is at the proper temperature and the air is needed for ventilation, it is passed around or through the auxiliary stack without additional heat, and unobstructed.

4. Tempering coils are absolutely necessary in case of humidifying as the air cannot be humidified unless it is 40° F. or above, as it will not physically absorb moisture and is apt to freeze the water.

The foregoing reasons are sufficient to warrant the use of the two sets of coils and make it exceedingly bad practice to omit the tempering coil.

LEGAL DECISIONS

Extensions.

A gas company was required by the California Commission to extend its mains for lighting and heating purposes to serve residents in an outlying section upon condition that applicants guarantee for three years a minimum charge sufficient to meet their proportion of the operating expense and 10% of the cost of the extension, to cover interest and depreciation thereon, where the prospective revenue would not justify an extension under ordinary conditions. . Lofgren vs. Pacific Gas & Electric Co., California.

Rate Making.

The Colorado Springs Light, Heat & Power Company, a public utility engaged in the sale of electricity for lighting, heating and power purposes, and in the sale of gas for lighting and heating, and of steam for heating purposes, is the owner of three properties of the following present fair value for rate-making purposes, *viz.*, electrical property, $1,481,762; gas property, $710,917; steam property, $122,774. In an application by the company for an increase of gas rates, it was held that excessive rates should not be charged for one kind of service in order to maintain the other two properties of the company. *Re* Colorado Springs Light, Heat & Power Co.

Heating Systems for Automobiles.

The Circuit Court of Appeals, Sixth Circuit, holds that the Williams patent, No. 873,399, for a heating and ventilating system for automobiles, as the claims were amended to meet the requirements of the Patent Office, is for an indirect or circulatory system having as one of the elements of the combination a register which may be opened and closed by the occupants of the car, and is not infringed by a system which heats by direct radiation and has no register. "All heating apparatus," the Court said, "is one or the other of two types, direct or indirect. In the direct the heating body or box is in the room to be heated, and the radiator is *direct;* in the indirect the heating box is outside the room to be heated and it heats a body of air in passing over it, which body of air is then conducted to the room to be heated, thus *indirectly* accomplishing the result. The two systems are also distinguished as "radiating" and "circulatory." In the heating of houses the ordinary hot-air furnace is circulatory or indirect; the more common steam system, with a radiator in each room, is radiating or direct; though steam heating is sometimes applied on the indirect system by passing fresh air from outside over the body of steam coils in the cellar and carrying the heated air into the room through pipes and registers. The Williams patent belongs to the circulatory class. The defendant Pelton's patent belongs to the direct or radiatory class. He had two forms of his device. In the first, the radiating coil was below the floor of the car, and it was surrounded by a tight box, except as it carried an open grating on top and in the floor of the car. It might be possible to consider this as a radiator box. In the second form, the radiating coils were in the body of the car, and surrounded by no box, but partly covered by a protecting screen or hood." Pelton vs. Williams, 235 Fed., 131.

"When Steam is Turned on Plant" Construed.

In an action on a contract for installing a heating and ventilating plant, a provision in the contract that the second installment of the purchase price should be paid "when steam is turned on plant" was construed in accordance with the significance given to the term by the trade to mean when steam is generated in the boiler, circulates through the steam mains and branches leading to the radiators, and the plant is in operation. American Heating & Plumbing Corpn. vs. Salomon & Co., 195 Ill. App., 297.

◆

Bureau of Mines Working to Increase Efficiency in Heating and Power Plants.

One of the recommendations made in the last annual report of the Bureau of Mines, which has just been issued by Director Van. H. Manning, is that a special investigation be authorized to increase efficiency in the heating and power plants in the public buildings of the United States. It is also urged that such work be conducted with the advice and co-operation of the various bureaus and departments interested, because it will be necessary for engineers of the bureau to visit the plants in order to determine the best fuel to be used and what changes in equipment or method of apparatus are advisable, and to obtain data on fuel costs.

◆

British Heating Engineers Recommend Use of Metric System.

An important action taken at the annual meeting of the Institution of Heating and Ventilating Engineers during its sessions in London, last October, was a proposal "that the members should adopt whenever possible the use of the metric system."

◆

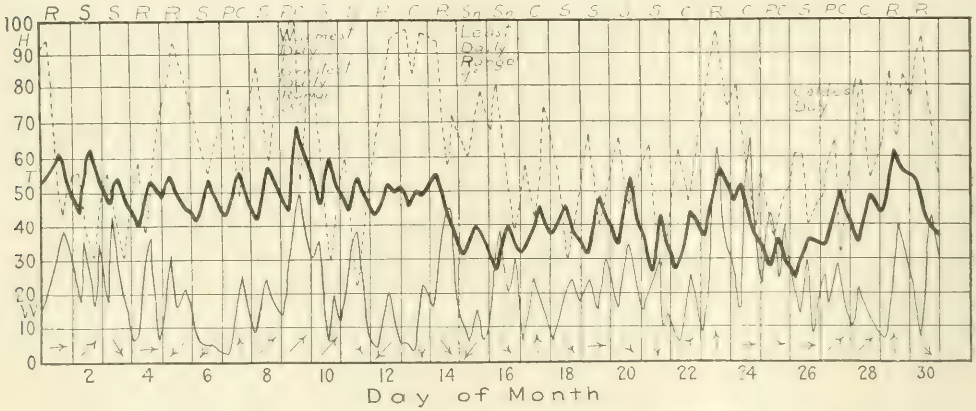
Current Heating and Ventilating Literature.

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

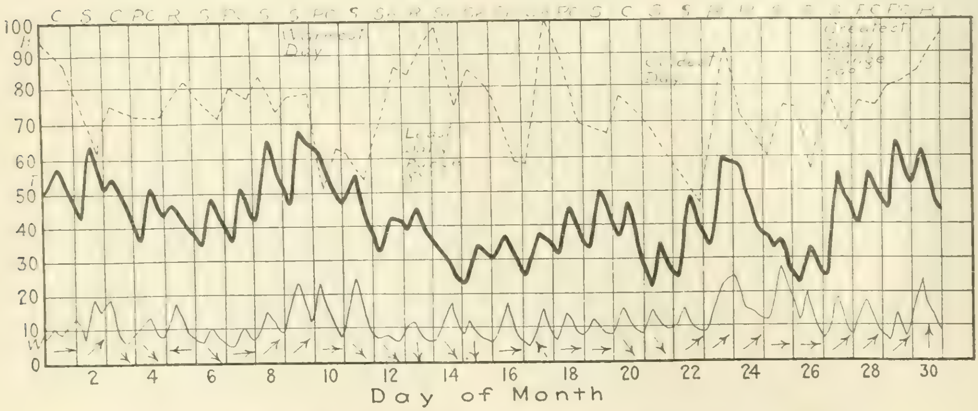
Vacuum Heating Systems. Charles L. Hubbard. 1500 w. Pwr—Oct. 3, 1916. Details of three systems in present use. 20c.

The Weather for November, 1916

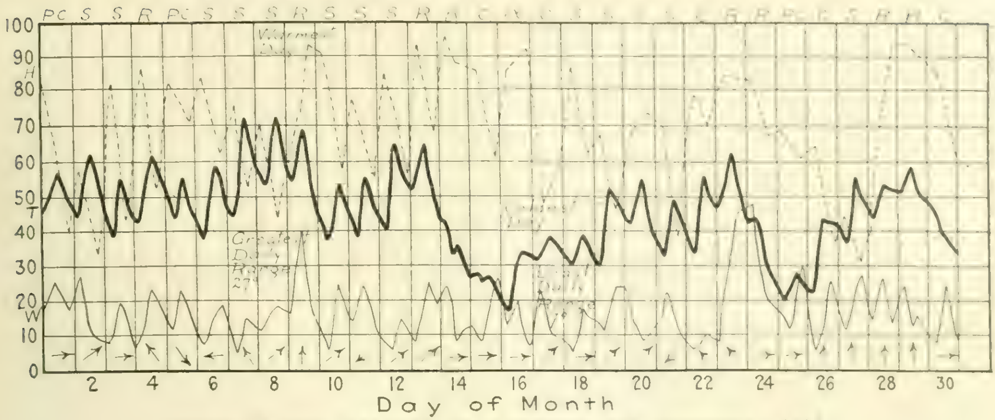
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature degrees F.	69	68	71	74	79
Date of highest temperature	9	9	8	6	4
Lowest temperature, degrees F.	25	22	18	14	15
Date of lowest temperature	26	21	16	14	14
Greatest daily range, degrees F.	25	29	27	25	28
Date of greatest daily range	9	27	7	6	16
Least daily range, degrees F.	9	8	7	3	9
Date of least daily range	15	13	17	11	24
Normal temperature for month, deg. F.	44.7	43	44	43.2	49.2
Normal mean temperature for month, deg. F.	44	41.2	42.9	39.2	43.4
Total rainfall, inches	1.57	1.67	1.86	2.11	2.53
Total snowfall, inches	Trace	0.7	0.3	0.1	0.1
Normal precipitation, this month, in.	3.44	4.1	2.55	2.5	2.88
Total wind movement, miles	12800	7687	9157	10354	11047
Average hourly wind velocity, miles	17.8	10.7	12.7	14.4	15.3
Prevailing direction of wind	S.W.	W.	S.W.	S.W.	S.
Number of clear days	13	11	13	11	19
Number of partly cloudy days	4	8	5	7	4
Number of cloudy days	13	11	12	12	7
Number of days on which rain fell	10	8	8	9	5
Number of days on which snow fell	2	5	4	.5	2



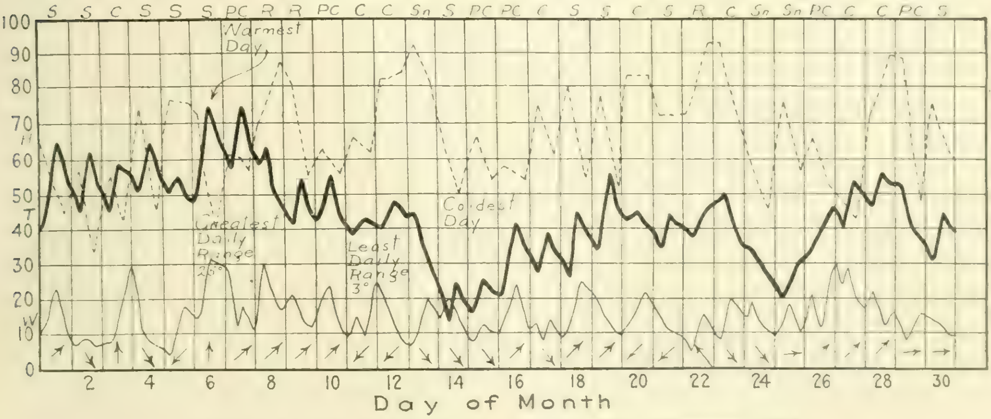
RECORD OF THE WEATHER IN NEW YORK FOR NOVEMBER, 1916
(Hourly Observations of the Relative Humidity Are Recorded on This Chart.)



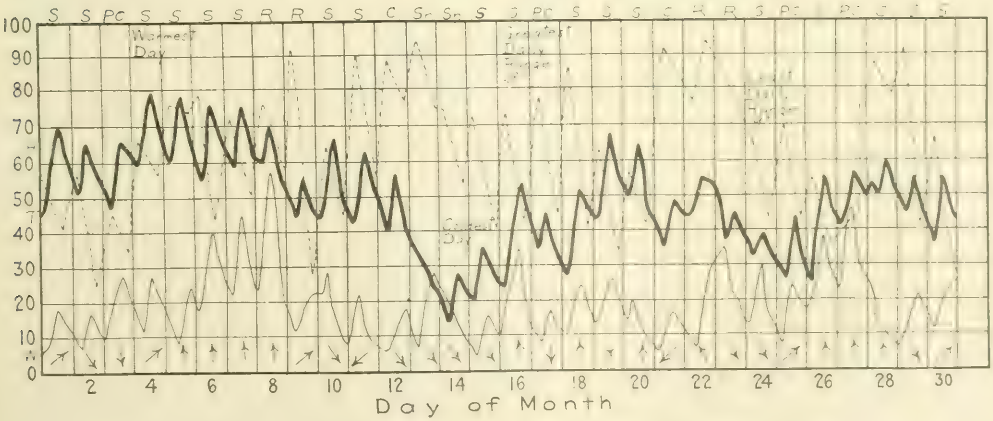
RECORD OF THE WEATHER IN BOSTON FOR NOVEMBER, 1916.



RECORD OF THE WEATHER IN PITTSBURG FOR NOVEMBER, 1916.



RECORD OF THE WEATHER IN CHICAGO FOR NOVEMBER, 1916.



RECORD OF THE WEATHER IN ST. LOUIS FOR NOVEMBER, 1916.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing direction of wind.

CORRESPONDENCE

Variations in Engineering Practice.

Editor Heating and Ventilating Magazine:

As the author of Question No. 67, which appeared in the November issue, I wish to thank you and the "Consulting Engineer" for the time spent in replying to the query. As for the answer, however, it looks like an evasion, or lack of knowledge, which a consulting engineer should not have to admit.

It may be of interest to you to know that all your subscribers are not heating engineers and I have no doubt that a large number are students, probably engaged for the most part in offices doing a heating business. As for myself, I am an architectural draftsman desiring to acquaint myself with as much knowledge relative to heating as possible, hence my reason for subscribing to your magazine. If we were all first-class heating engineers, I fear that The Heating and Ventilating Magazine would be of little use, for then the diffusion of knowledge pertaining to heating would be unnecessary.

Now if this line of reasoning is true, then when articles are written or advice given by technical men, they should not lose sight of the fact that it will be the weakest among the readers that will absorb the most and he is frequently the one who cannot so readily separate the facts from assumptions, unless they are so marked.

In looking over some back numbers on the subject of heat transmission from radiators, I note that the different authors are at variance with each other to a marked degree. In the issue for May, 1914, George Stumpf, Jr., gives two tables in his article which I copied at the time and have used in my work with satisfaction, as far as I know. In the issue for March, 1915, Charles A. Fuller gives a table taken from a book of which he is author, and in the issue for September, 1915, E. D. Bottsford gives a table which is from 3% to 5% higher than the values given by Mr. Fuller. Herewith are the three tables for comparison.

It is not my purpose to criticise any of these authors, but I would like to point out the glaring need of a board or society to decide once and for all (as suggested by Professor John R. Allen in the issue for September, 1914) or until such time as tests will prove otherwise, such points as the above. If this cannot be done, then let one of the leading magazines representing the heating profession step in and lead the way, so to speak. Then may I ask what magazine is in a better position to do this work than The Heating and Ventilating Magazine?

Permit me to call your attention to the article in the issue for November, 1916, by E. B. Johnson. There, we see, he has taken an average from different authorities for the loss of heat through glass per square foot per hour for a difference of 70° F. between inside and outside temperatures, as 71 B.T.U. In articles published in other magazines for the same conditions, Mr. Fuller allows 70 B.T.U., Mr. Hubbard allows 85 B.T.U. and Mr. Russel allows 84 B.T.U. Here Mr. Hubbard is 21.4% higher than Mr. Fuller.

Referring to the same article mentioned above, in Table 3 you will note that for a

B.T.U. TRANSMITTED PER SQUARE FOOT PER 150° F. DIFFERENCE BETWEEN TEMPERATURE OF STEAM IN RADIATOR AND THAT OF AIR IN ROOM.

Height of radiators.

	Charles A. Fuller				Ed. D. Bottsford				George Stumpf, Jr.	
	22	26	32	38	22	26	32	38	22 to 26	32 to 38
One-col	285	279	275	270	300	295	290	285	287	261
2-col.	270	263	257	250	290	280	275	270	272	248
3-col.	255	248	240	231	270	260	255	250	238	210
4-col.	240	233	225	218	250	240	235	230	222	230
Window	278	...	...	...	...	...	...	...	...	...
Pipe coils	300	...	...	...	...	...	...	...	...	...
Vertical wall rad.	285	...	...	...	310	...	...	...	*272	
Horizontal wall rad.	292	...	...	...	300	...	...	...	*300	

* Average for 5 sq. ft. and 7 sq. ft. sections.

room temperature of 70° F., a radiator will give off 240 B.T.U. per square foot per hour. It has always been my impression that such would be the case when the steam in the radiator is at a certain temperature and that the room temperature is not the factor to be considered, but rather the difference in temperatures of the steam in the radiator and that of the air in the room. If we assume 1.67 B.T.U. per square foot per degree difference for a radiator, then 240÷ 1.67 = 144 + 70 = 214 which would be the temperature of the steam upon which the table is based.

It is my opinion that most men look to the magazines as the source from which they glean most of their knowledge and if such is true, then the articles should be written with that in mind. The foregoing is written without malice and in the hope that it is constructive, rather than destructive. Anybody can tear down, but it is hard to build and if what has been stated will help the one trying to build to see some of the requirements of the less-trained men in the profession, then what has been written will not be in vain.

F. W. P.

Pittsburgh, Pa., November, 1916.

REPLY BY IRA N. EVANS.

The writer regrets that he has created the impression that the correspondent's question was evasively answered. The question referred to concerned the relative merits of different types of gas heaters when used for heating purposes, questioning, we assume, some of the manufacturers' statements as set forth in their literature. If the manufacturers will back up their statements with a written guarantee in any particular case, it would seem to the writer a superior engineering opinion to any we could furnish.

The correspondent refers to a series of transmission for radiation, questioning a 5% difference in results, as shown by different authors. It is difficult to see the connection, inasmuch as these transmissions would not apply to the gas heater conditions.

There is danger of error in using engineering data taken from various sources, unless assured of its reliability, either from experience or research. The transmission figured out in our answer is within the limits obtained for fan coils, which are analogous to the case in hand, and it is so stated in the answer. It seems to us that the simple and inexpensive method indicated of testing the apparatus would enable the correspondent to obtain his information first hand. There are, however, a series of exhaustive tests made by Willis H. Carrier and presented to the American Society of Mechanical Engineers (published in THE HEATING AND VENTILATING MAGAZINE for January, 1912, which give the coefficients for a wide range of temperature of air over heating surface. These, however, would be useless unless the velocity and temperature of the gas and water were known or assumed.

It would, no doubt, be a good idea to have a board of engineers pass on the reliability of data, but they could not furnish any data themselves by simply meeting together, as these tests take time and money.

There is no question that there are puzzling discrepancies in many of the data on heating, but there is reason for this as it is almost impossible to hit upon the future condition of a building in the plan stage, as to heating, with absolute certainty. The only thing we can do is to get enough surface to meet the possibilities.

In designing steel work, a factor of safety of four or five is used, because it is never known what the overload is likely to be and the structure can only fall once. In heating practice, if the apparatus fails, it can be added to at more or less expense, so that we do not need to allow the same factor of safety. On the other hand, if our price is high, we lose the job.

Figuring Duct and Flue Sizes.

EDITOR HEATING AND VENTILATING MAGAZINE:

Referring to the article "Comparison of Various Methods of Figuring Duct and Flue Sizes" in the October issue, Table No. 4 gives the following outlet distances:

E F = 100 + 50 = 150 ft.
G = 120 + 50 = 170 ft.
H = 140 + 50 = 190 ft.

By count on plan of Fig. 1, I get:

E F = 120 + 50 = 170 ft.
G = 140 + 50 = 190 ft.
H = 160 + 50 = 210 ft.

Why is the distance, E., left out?

Los Angeles, Cal., November, 1916.

L. A. W.

REPLY BY H. A. ALT.

The distance, E, referred to by correspondent, is not a *duct* distance but is a vertical *flue* length of 20 ft. The United States government does not consider the length of a vertical flue as having any direct bearing on the size of a duct supplying same, and therefore, the length, E, was omitted in computing the length of the *duct* traversed by the air to the outlets in question.

Undoubtedly this treatment is based on the fact that warm air in a flue will usually not only overcome the flue friction but will make the flue act as a chimney, actually causing an acceleration of flow for a high flue. Witness the increased velocity in a hot air furnace pipe leading to the second floor (generally figured at 380 ft. per minute) against the velocity in a similar pipe leading to the first floor (where only 260 ft. velocity is attained.)

Of course, where air for ventilation only is supplied, this being at 70° F. and the same as the room temperature, the chimney action is not present, but on most systems the air is likely to go over 70°, rather than under it, and so in the majority of cases it is entirely correct to omit a vertical flue in considering duct resistance to air flow.

The United States government rule as given in "Mechanical Equipment of Federal Buildings" is as follows:

> "Main duct at the fan is to be made the same size as the fan outlet . . . Refer to equalization table and note how many 1 in. x 1 in. pipes are given as being equal in carrying capacity to this main duct. Divide number of pipes by capacity of fan in C.F.M." (This gives the "factor" as mentioned in the article.) "Multiply amount of air delivered to the base of each flue by the distance of said *flue* from the fan (distance meaning length of *duct*, adding equivalent for turns, etc.) and divide this product by the amount of air handled by the fan. This gives the average distance of all *outlets* from the fan. Next multiply the amount of air to each flue by the fraction" (factor) "above obtained. This will give the number of 1 in. x 1 in. pipes to be allowed to each flue. This number is subject to correction as follows:
>
> "For *each 1 foot* by which the distance (including the equivalent for bends) from *fan* to *base of flue* exceeds the 'average distance' previously obtained, 1/3 of 1% is to be added to the number of 1 in. x 1 in. pipes previously allowed for each flue. If the distance is less than the 'average distance' the correction is to be deducted instead of added.
>
> "Now refer to equalization table and find the size of square pipe equivalent to the corrected number of 1 in. x 1 in. pipes for each flue. This is the size of the branch pipe at the base of the flue. Add all the branches back to the fan on the equalization table, and if the work is correct it will add up the size of main duct you started with."

It will be seen from this that no attention is paid to flue lengths and their velocities are later stated as being about 600 ft. per minute. In order to suit the particular system used as a sample some of the conditions were not the ones commonly encountered in government work where, according to the explanation, they evidently put all the horizontal ducts in the basement with vertical flues running direct to the outlets above and do not have additional horizontal runs from the top of the flues, such as is shown at the top of Flue E in Fig. 1. However, the object of the article was to indicate the various general schemes of sizing without going very much into the finer details of design, and it would seem that this method is longer and more tedious than some of the others given which produce equally good and efficient results.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Programme for Annual Meeting.

The two outstanding features of the forthcoming meeting of The American Society of Heating and Ventilating Engineers, in New York, January 16-18, will be a session on drying and one on boiler testing. The drying session will be given over to the reading and discussion of three papers, one by F. R. Still, of the American Blower Company; one by J. O. Ross, of the B. F. Sturtevant Company; and one by G. C. Shadwell, of the Improved Appliance Company, of Brooklyn. The boiler testing session will start off with a presentation of the principal points brought out in the paper on "Testing of House Heating Boilers," by Professor L. P. Breckenridge and D. B. Prentice, presented at the recent annual meeting of the mechanical engineers' society. This will be followed by a report of the committee of the New York Chapter which is at work on the project of perfecting a boiler testing code that can be used as a standard. The subject will then be open for general discussion.

Among the papers scheduled for the various sessions are the following:

"Transmission of Steam in a Central Heating System," by J. H. Walker, of Detroit.

"The Efficiency of Underground Conduits," by George H. Nichols, Chief Engineer, Office of State Architect, Albany, N. Y.

"Heating, Ventilating and Electrical Equipment in the Philadelphia School Buildings," by J. D. Cassell, Chief Engineer, Board of Education, Philadelphia.

"Some Notes on Warm Air Furnace Heating," by J. M. McHenry, of Detroit.

"Heating of Temporary School Buildings, in Detroit," by J. R. McColl.

"New Type of Dust Separator," by William J. Baldwin, New York, supplementing his talk and demonstration at last summer's Detroit meeting.

"Prevention of Corrosion in Pipe," by F. N.

Speller, Pittsburgh, supplementing a paper on the same topic presented last year, and containing new test data obtained by use of deoxidizing method for taking oxygen out of water.

ENTERTAINMENT PROGRAMME.

In this year's entertainment programme, a feature will be made of luncheon and matinée parties for the visiting ladies. On Tuesday afternoon, the opening day of the meeting, the ladies will be taken to the Rialto to see the moving pictures and later will meet for a dinner party at Churchill's. There will be nothing special on the programme Wednesday morning, but in the afternoon a matinée party will be made up to see "Follow Me," at the Casino.

The annual dinner of the society will be held at the Hotel Astor. A different banquet hall has been secured from that of last year, this year's quarters being on the ground floor on the 44th Street side.

The Thursday programme consists of visit to Wanamaker's where luncheon will be served and the party will later hear a piano and organ recital in the auditorium.

The members of the Entertainment Committee are: A. S. Armagnac, chairman; R. W. Pryor, Jr. (dinner), P. H. Seward (finance), William H. Driscoll (ladies), George D. Farnham (programme), M. W. Franklin (speakers), D. D. Kimball, W. H. McKiever, George W. Martin, Walter S. Timmis, A. E. Carpenter, Jr., G. A. Dornheim, E. F. Glore, W. G. LeCompte, H. G. Issertell and B. K. Strader.

Address on Form for Choosing Bidders and Awarding Contracts Presented Before Illinois Chapter.

A live topic was up for discussion before the Illinois Chapter at its December meeting when Herman Wallace Nelson addressed the meeting on "The Nelson Form for Choosing Bidders and Awarding Contracts." One of the principal features of the plan proposed by Mr. Nelson is that providing for compensation for estimates submitted. "Competition," said Mr. Nelson, "is essentially an American Institution, but I do not believe in the kind of competition some architects believe in." The building owner, he declared, who receives the benefit of competition should pay for that competition and justly distribute the cost of same. The uncertainties of the business, he added, of which that of free estimating occupied a prominent place, was the cause of such a low proportion of successes as are reported in the heating contracting business.

Mr. Nelson's remarks were listened to by an appreciative gathering of over forty of the chapter's members and guests. At the conclusion of his talk he was given an enthusiastic vote of thanks.

The meeting, which was held at the Engineers' Club, Chicago, December 11, was opened by President F. W. Powers. Before the main subject of the evening was taken up, it was voted to invite the American Society of Heating and Ventilating Engineers to hold its next mid-summer meeting in Chicago.

The main features of the Nelson forms for choosing bidders and awarding contractors, cover the following items:

1. That the owner of a building may have just as much fair competition as he wishes to pay a reasonable and fair price for.

2. That when and after the owner has chosen his competition in a fair, unprejudiced manner, and has further paid a just and reasonable price for such competition, he shall be under no moral or other obligation to the bidders.

3. That the owner may, as he chooses, select a limited or large number of bidders. If the work is of a private nature, he may wish to choose a very limited number, if he wants competition at all.

4. If the work be of a public nature, the owners may have good reason for first selecting a limited number of bidders, because of their residence, near the work, or because they may be familiar with or may have had previous experience with the work, or for other justifiable reasons.

5. That when the owners, in case of public work have chosen their preferred bidders, they may give every other public citizen who is qualified to bid, an opportunity to compete by chance or lot for consideration as a bidder, limiting the number to be chosen in accordance with the value of the competition to him.

6. That if an owner cannot or will not provide complete detailed plans and specifications for the work, but wants estimates, measurements, figures or advice of a professional nature, the owner shall consider such work in the light of a professional service, and it shall not be considered proper, fair or just to ask for competitive price bids, but that the charges for such service shall be left solely for adjustment between the owner and the contractor either before or after the work is done.

New York Chapter Advances Movement for Standard Boiler-Testing Code.

A decided impetus was given at the December meeting of the New York Chapter to the movement to formulate a standard method of testing house-heating boilers. This matter has been growing more pressing ever since the power boiler code of The American Society of Mechanical Engineers was adopted, but the immediate cause of its discussion at this time was the paper presented before the mechanical engineers' society last month (published in The Heating and Ventilating Magazine for December) by Professors L. B. Breckenridge and D. B. Prentice on "The Testing of House Heating Boilers."

The guests of honor, all of whom came prepared to discuss the proposition at length, were André Mertzanoff, chief engineer of the American Radiator Company's Institute of Thermal Research, in Buffalo; Professor John R. Allen, president of the Detroit Chapter of the heating engineers' society; and E. E. McNair, general manager of sales for the United States Radiator Corporation of Detroit.

As a result of the discussion Homer Addams, P. H. Seward and Walter S. Timmis were appointed a committee to prepare a report on the project for submission at the annual meeting of the heating engineers' society in January.

The chapter met as usual at the Building Trades Club and was called to order by President Arthur Ritter. After the routine business was disposed of, including a report from the chapter's entertainment committee, the chairman turned the meeting over to Homer Addams who was in charge of the December programme.

Mr. Addams lost no time in expressing his conception of the purpose of the meeting, which was to take some practical and definite steps to push along the preparation of a code so that the society, at its annual meeting, could take action that would lead to its final adoption, and thus receive the proper credit for such a code, which, he said, at present it is in danger of losing.

André Mertzanoff, who was the first speaker, was introduced by Frank T. Chapman. Mr. Mertzanoff told in an interesting manner of the methods used in Europe for the testing of low-pressure boilers and explained how the results of these tests were published under government auspices, thus giving an unquestioned authority to the findings.

The next speaker, E. E. McNair, took up in detail the recommendations made by Professors Breckenridge and Prentice. He considered that a classification of boilers such as that recommended in the paper referred to, where it was proposed to limit heating boilers to those up to 2,000 sq. ft. radiation capacity is unnecessary. He proposed that the distinction should be that of power boilers and low pressure boilers, the latter being one that returns the condensation to the boiler. He also proposed that boilers should be tested at their maximum efficiency. As to a test of 12 hours, he said boilers are usually rated on 8-hour firing periods, so that a 12-hr. test would not be sufficient. A test of 24 or 32 hours would be more like what is required.

The United States Radiator Corporation's method is to test the boiler when operating at atmospheric pressure. The steam generated is carried through a separator and exhausted to the open air. Credit is given the boiler for raising the temperature of the water from feed temperature to 212° F. To this amount 2% is arbitrarily added for moisture. Mr. McNair described the test in detail, the boiler being given a "running start" before the test is commenced.

In concluding he stated that besides the proposed boiler code the trade needs a standard code for testing radiators, and he proposed the establishment of a national testing bureau for appliances used in heating and ventilating work. While the manufacturers' tests are good, they are always likely to be questioned, he said, simply because they are made by the manufacturers themselves.

Prof. Allen, who then spoke, called attention to the fact that the Breckenridge and Prentice code provides for no firing rate. The length of test, he said, must be some multiple of that rate. He commended the thoroughness of the European boiler tests as described by Mr. Mertzanoff, which he described as giving "so many B.T.U. at the steam nozzle." He also endorsed the idea of a running start and in testing at atmospheric pressure. As chairman of a committee of the society on testing, he stated that he hoped to have something in connection with a code for testing radiators which would be ready for the next midsummer meeting of the society.

Professor Allen said that he had no doubt the University of Michigan would be glad to nationalize its testing bureau. He urged that such a bureau should be under the direction of a committee of the society.

A written discussion by Roy E. Lynd, of the Richardson & Boynton Company, was presented and was referred to the chapter's new committee on the subject.

Before the vote was taken on the appointment of the committee, P. H. Seward urged that the work of compiling a testing code should not attempt to include that of rating boilers. "What we need," he said, "is some standard method of testing by which a purchaser can make a comparison of two or more boilers under his consideration; in other words, a test code for the actual capacity and efficiency of heating boilers under ordinary operating conditions, as distinguished from commercial ratings."

Eastern Pennsylvania Chapter.

Stewart A. Jellett, former president of The American Society of Heating and Ventilating Engineers, was the principal speaker at the December meeting of the Eastern Pennsylvania Chapter, held at the Engineers' Club, Philadelphia, December 14. His subject was "The Duty of the Engineer to His Client and Himself." Mr. Jellett urged the engineer to take into consideration more fully the needs of his clients and to fulfill them with economy and efficiency at all times.

The attendance surpassed that of any previous meeting of the chapter and included the following guests: E. C. Wiley, Lynchburg, Va.; W. S. Moffett, Staunton, Va.; and James A. Donnelly, New York.

At the dinner, which preceded the technical meeting, a leather tobacco pouch, bearing the chapter's monogram, was presented to each guest, by the chapter. Accompanying this souvenir was a novel briar-wood pipe, made to be filled from the bottom, designed and presented by James A. Donnelly.

The following were elected to membership in the chapter: John Gormly, honorary; R. C. Bolsinger, C. E. Bonnet, M. G. Gillett, George A. Haupt, John J. Liner, William J. Murphy, P. M. O'Connell and Charles G. Reever, regular; and H. D. Kellogg, associate.

◆

American Public Health Association is about to inaugurate a health employment bureau whereby the services of members of the association may be brought to the notice of prospective employers. Employers will be notified of the creation of the bureau with the idea of stimulating them to appeal directly to the bureau when they are in need of expert aid. Selakar M. Gunn, 755 Boylston St., Boston, is the secretary of the association.

Industrial Drying Requirements.

An inquirer in *Lefax* asks: "We are confronted with a problem of drying the stock from which buttons are made. Would appreciate any information along this line and data on temperature and humidity."

The following answer was received from a *Calabur* member: "The following information may be helpful in solving the drying problem. Because the querist does not state what the buttons are made of, nor what system of drying is employed or contemplated, a direct answer cannot be given.

"Nature and mechanical means of drying both rely on warm, dry air in motion to absorb the moisture from material. Air with 50% humidity is considered dry. It contains only one-half the full amount of moisture it is capable of carrying. At a higher temperature the air can carry more moisture.

"Humidifiers or dehumidifiers may be necessary to give the desired amount of moisture in the air, or part of the used air, recirculated, may fill the conditions. For the heat requirements, direct radiation, warm air currents or a combination of the two, are used. Natural circulation is often depended on in warm air installations; fans are also employed. The temperatures required are different, depending on the nature of the product to be dried. In various operations, it is even necessary to vary the temperature during the drying period.

TABLE I. TEMPERATURE CONDITIONS FOR DRYING PROCESSES.

Material	Deg. F.
Apples	140-180
Bathing suits	120-180
Bedding	150-190
Blankets	140-180
Cereals	110-150
Feathers	150-180
Films, photo	90-110
Furs	150-190
Glue, bone and skin	70- 90
Hair goods	150-190
Hats, felt	140-180
Hats, ladies, glued	140-180
Hides, sole and thin leather	80- 90
Ink, printers	90-200
Knitted fabric	140-180
Macaroni	110-150
Matches	140-180
Nuts	90-140
Papers, treated	150-200
Pottery	110-120
Rags	120-180
Ribbons, pasted	160-200

Rope	120-180
Soap	80-100
Starch	180-200
Tapes, glued	160-200
Tobacco, leaf	70- 90
Tobacco, stem	170-200

The quantity of warm air for drying and its temperatures are the main factors. The practical ranges in temperature suitable for drying different products are given in Table I. The air supply required depends upon the rate at which the moisture is given up by the material. The air change frequency varies with every condition, the range being from 2 to 5 changes per minute in the drying chamber.

A rule-of-thumb for determining the volume of air required for a drying process allows 2½ changes of air per minute in the drying chamber. The temperature of this warm air supply to be considered as the highest value given in Table I, corresponding to the material that is to be dried.

A closer approximation of drying requirements may be arrived at with the aid of Table II. The figures give the quantity of air necessary at saturation to evaporate one pound of water at the corresponding temperatures of the air entering the drying chamber. These values are based on the theory that the air will leave the dryer completely saturated. In practice it is found that the air does not remove more than 50 to 70% of the moisture, and allowance should be made for same.

Table II. Cubic Feet of Air at Saturation Required to Remove 1 lb. of Moisture When the Air Entering Heater is at 70 Deg., Saturated or Half-Saturated.

Temp. of warm air. Deg. Fahr.	Cubic feet required	
	Entering Air 100% Rel. Hum.	Entering Air 50% Rel. Hum.
80	8240	3300
90	4050	2380
100	2640	1845
110	1965	1515
120	1525	1270
130	1280	1085
140	1090	950
150	934	845
160	827	755
170	732	685
180	662	625
190	600	575
200	562	530

Assume a condition where rope has to be dried at a temperature of say 160° F. The drying chamber has a contents of 600 cu. ft. While wet, the rope weighs 350 lbs., and after being dried, the weight is 250 lbs., requiring that 100 lbs. of water be removed. With the air entering the heater saturated, 827 cu. ft. of air will be required per pound of water as in Table II, for 160° temperature. Then 100 lb. × 827 cu. ft. equals 82,700 cu. ft., which is the volume of air necessary for drying the rope. If it were required to complete the drying process in 120 minutes, then the warm air supply would have to be delivered at the rate of 689 cu. ft. per min. This gives a theoretical air frequency of 689 divided by 600 or 1.15 changes per minute.

In making allowance for a practical installation, it should be remembered that the air in absorbing the moisture from the rope will be only a little more than half saturated. On a 50% basis, therefore, the volume of air will have to be doubled if the time remain 120 min. or the time extended to 4 hours if the air volume remain as above.

NEW DEVICES

New Smokeless Type of Capitol Boiler.

A widespread curiosity on the part of the heating trade has been gratified in the publication of data regarding the new smokeless type of Capitol boiler, which has recently been placed on the market by the United States Radiator Corporation, Detroit, Mich. Unlike most smokeless boilers, this construction discards the downdraft principle. It is largely built according to the general recommendations for the construction of smokeless furnaces as made by D. T. Randall, of the Bureau of Mines.

1. The coal should be supplied to the furnace in small quantities at frequent intervals. The more nearly the feed approaches a continuous and uniform supply the better the results.

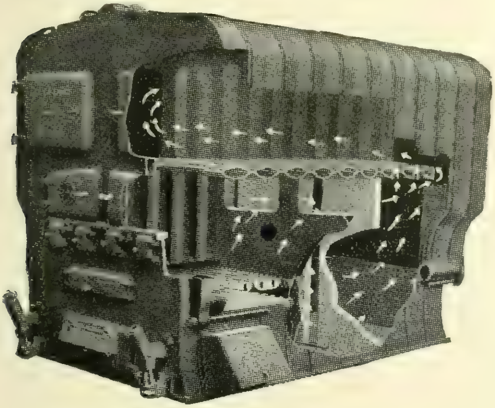
2. The air supply should be slightly in excess of the theoretical amount required and be admitted principally through the fuel bed, with an auxiliary supply admitted at the front or rear of the furnace to burn gases from the coal.

3. The temperature in the furnace should be sufficiently high to ignite the gases given off from the fuel bed.

4. There should be a fire-brick combustion chamber of sufficient dimensions and

so designed as to cause the thorough mixture of the gases and air, permitting complete combustion before the mixture reaches the boiler surfaces.

As will be noted from the illustration, this boiler contains a large fire-box or furnace where bituminous coal is burned at a rapid rate of combustion. The air is admitted principally through the grates and fuel bed, with an auxiliary supply admitted at the front of the furnace, which mixes with the volatile gases distilled from the fuel bed. These volatile gases pass from the furnace into the mixing chamber through two horizontal openings at the top and in the back or bridge wall of the furnace. The mixing chamber back of the furnace is formed by the bridge wall at the front and an ignition wall of fire brick at the rear of the mixing chamber.



CONSTRUCTION OF CAPITOL SMOKELESS BOILER.

The passage of the gases from the mixing chamber to the combustion chamber at the rear of the boiler is through a long, vertical opening in the ignition wall, permitting a congestion and intermixture of burning gases, and their complete combustion in the combustion chamber. It is stated that the principle of complete combustion before the gases are cooled, as opposed to the downdraft principle, in which the cooling of the volatile gases begins at the upper or water grate, results in exceedingly high efficiencies.

Another advantage mentioned for this type of boiler is that no skilled attendance is necessary to obtain smokeless results. As the design provides for the complete combustion of the volatile matter in the boiler, there is no smoke to escape to the open air except during the time when the fire doors are open and coal is being fed to the boiler. It is stated that any of the bituminous coals may be used, including the lignites from the far West, at the same time complying with the requirements of any smoke ordinances of any city in the United States.

The Capitol smokeless boiler is made in five sizes for steam and sizes for hot water, with steam ratings running from 6,275 to 9,775 sq. ft. of direct radiation and water ratings from 10,000 to 15,650 sq. ft. The company has recently published a bulletin devoted to this boiler which gives full details, including tapping measurements and other data, including price lists.

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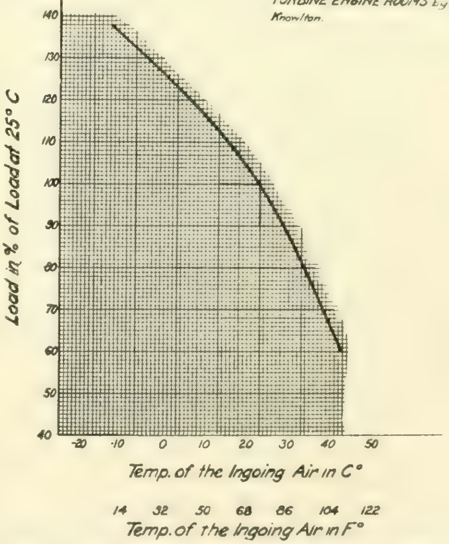
Trade Literature.

Spraco Eqipment, for washing and cooling air, especially applicable for steam turbine generators and other electrical machinery, is the subject of a carefully-compiled catalogue issued by the Spray Engineering Co., Boston, Mass. The fact that all modern electric generators are designed for a certain allowable maximum temperature in the armature and field windings makes some means for cooling them a matter of importance. With a given load, the temperature of a generator will be a fixed amount above the temperature of the ingoing ventilating air; therefore, the cooler the air delivered to the generator, the greater will be its capacity. The cleanliness of the air is also an important feature. The gain in capacity with cool air is worked out in the form of a chart giving the K.V.A. load



Taken from the GENERAL ELECTRIC REVIEW of September, 1913 in a article entitled VENTILATION OF STEAM TURBINE ENGINE ROOMS by Edgar Knowlton.

PERMISSIBLE LOAD ON A TURBO-ALTERNATOR AS A FUNCTION OF THE TEMPERATURE OF THE INGOING AIR.

on turbo-alternators as a function of the entering air, and since the standard air temperature for electrical machinery is 25° C. (77° F.), 100% load is taken at this temperature. As an example, the temperature is assumed to be 90° F. (32.2° C.) with a relative humidity of 45%. The curve shows that with air at this temperature the safe capacity of the generator is only 87% of full load rating. If the air is passed through a Type B Spraco air washer and cooler, it may be reduced to a temperature of 74° F. (23.3° C.) or less, enabling the generator to carry 102½% load, resulting in a gain of approximately 15%, as the power required to operate the washer is but a fraction of 1% of the generator rating. The catalogue shows the different types of Spraco air washers, including typical installations. At the end is a list of 98 installations. Pp. Size 8 x 10¾ in. Pp. 16.

PROGRESS IN HOT WATER HEATING is the title of a revised and enlarged edition of a handbook devoted to the D. and T. tank-in-basement equipment, manufactured and sold by the D. & T. Mfg. Co., St. Louis, Mo. This system, primarily, is one for regulating the drafts on hot water heating boilers by means of the natural law of water expansion under increasing temperatures. The handbook goes on to describe the various devices used in this system including the D. and T. regulator, D. and T. air-sealed pressure controller and the D. and T. pressure gauge. Size 3¾in. x 6 in. Pp. 124.

VALVE WORLD for December, 1916, the monthly periodical of Crane Co., Chicago, contains, among other things, a readable article on "Des Moines, the City of Uncertainties." This issue closes the eleventh year in the life of the *Valve World*.

Organization of Braemer Air Conditioning Corporation.

Warren Webster & Co., Camden, N. J., announce that they have disposed of the business of their air conditioning department and on and after January 1, 1917, the Webster air conditioning apparatus will be manufactured and exploited by the Braemer Air Conditioning Corporation, Lafayette Building, Philadelphia, Pa. The new corporation has been formed by William R. Braemer, for many years manager of the air conditioning department of Warren Webster & Co. Besides conducting a general business in the manufacture and sale of air purifying apparatus, the new company will act as experts in air conditioning work in all its phases.

The best wishes of a wide circle of friends will accompany Mr. Braemer in his enlarged field of activity.

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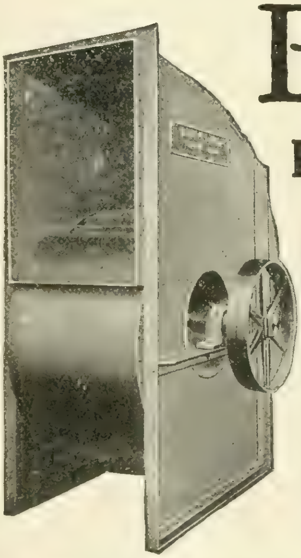

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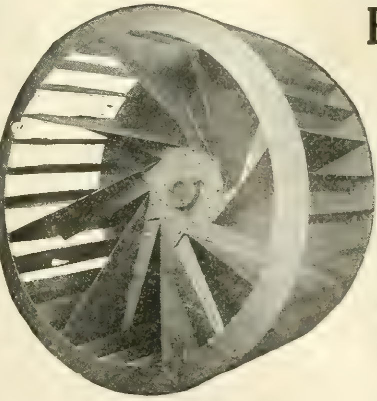

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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. FEBRUARY, 1917 1123 Broadway, New York

General Mechanical Equipment of the William Penn Hotel, Pittsburgh, Pa.

A Plant Designed to Meet Every Demand of the Modern Hostelry

One of the latest and most completely equipped hotels is the William Penn, recently erected in Pittsburgh, at Sixth Avenue and Oliver Street. The building is on a plot 216 by 129 ft. and has a height above the street of approximately 250 ft. Below the street level the basements extend to a depth of 55 ft. The cubical contents above the street are approximately 7,000,000 cu. ft.

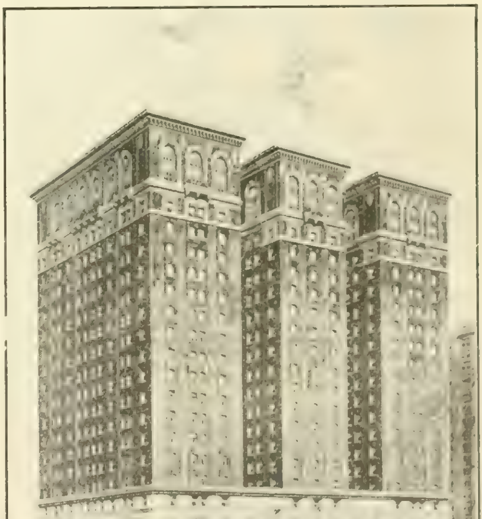
The main floor of the building is devoted to dining rooms and hotel offices. On the main floor mezzanine there is located the writing room and the main kitchen, which kitchen serves both of the main floor dining rooms.

Above this level there are sixteen floors of bedrooms on one of which, the parlor floor, is located the state suite. The above-mentioned sixteen bedroom floors contain nearly 1,000 bedrooms, each being provided with a separate bathroom. Serving pantries for service to the bedrooms are located on every third bedroom floor.

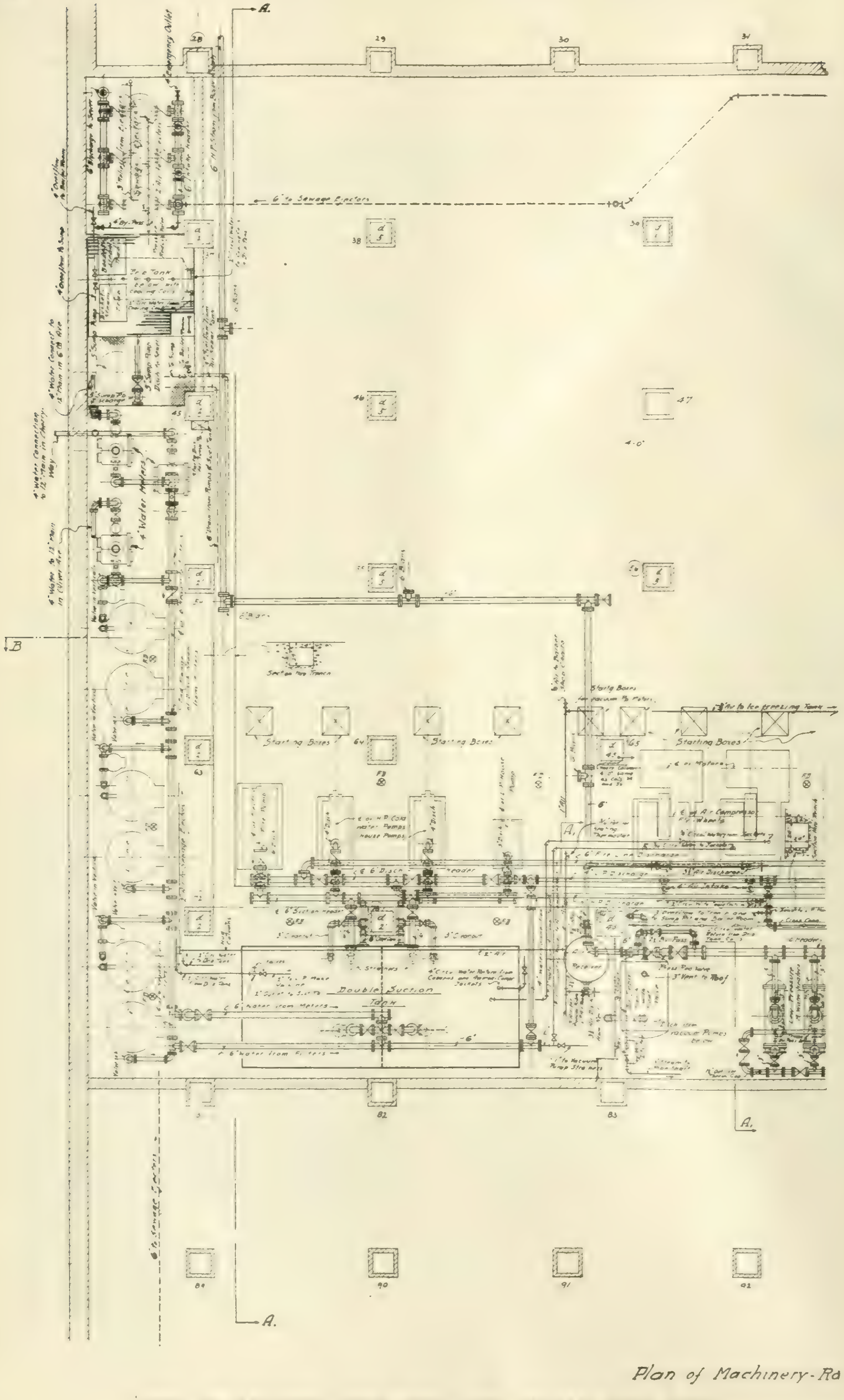
The sixteenth and seventeenth floors are devoted to the main ball room, banquet and private dining rooms. There are two kitchens for the service of these rooms which are located on the same floors.

Above the seventeenth floor the building is devoted to hotel operative departments and the general mechanical equipment, such as fans, elevator machines, water tanks, brine and drinking water balancing tanks.

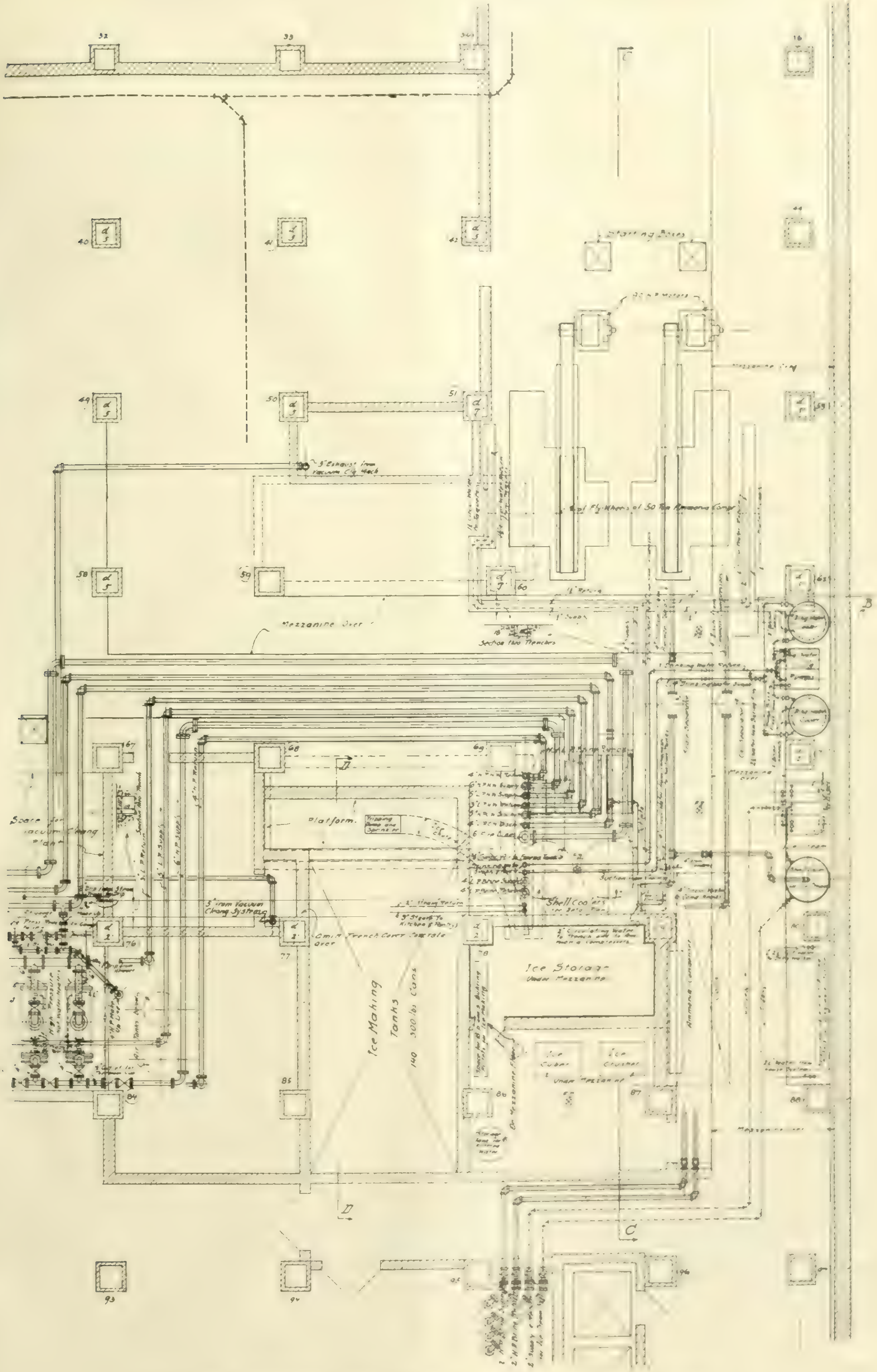
Below the street there are four levels, the first being the basement, containing the Elizabethan dining room, bar room,



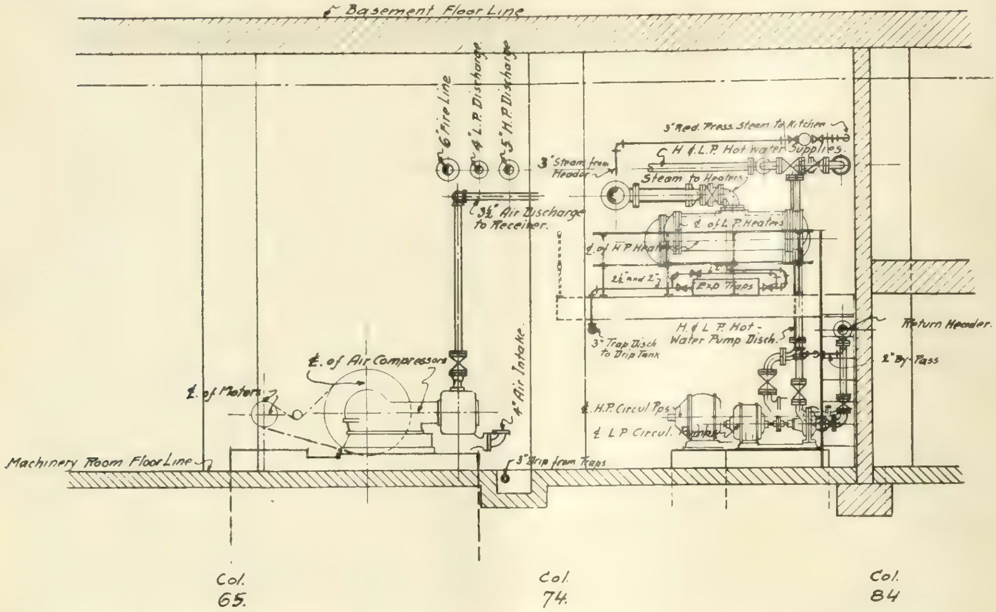
WILLIAM PENN HOTEL, PITTSBURGH.



PLAN OF MACHINERY ROOM, WEST SIDE, WILLIAM PENN HOTEL.



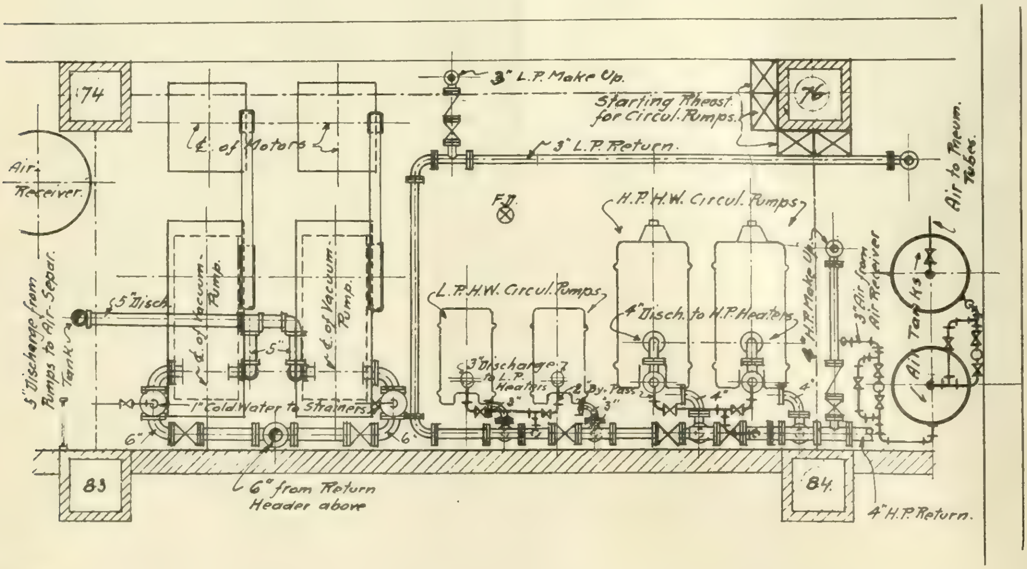
PLAN OF MACHINERY ROOM, EAST SIDE, WILLIAM PENN HOTEL.



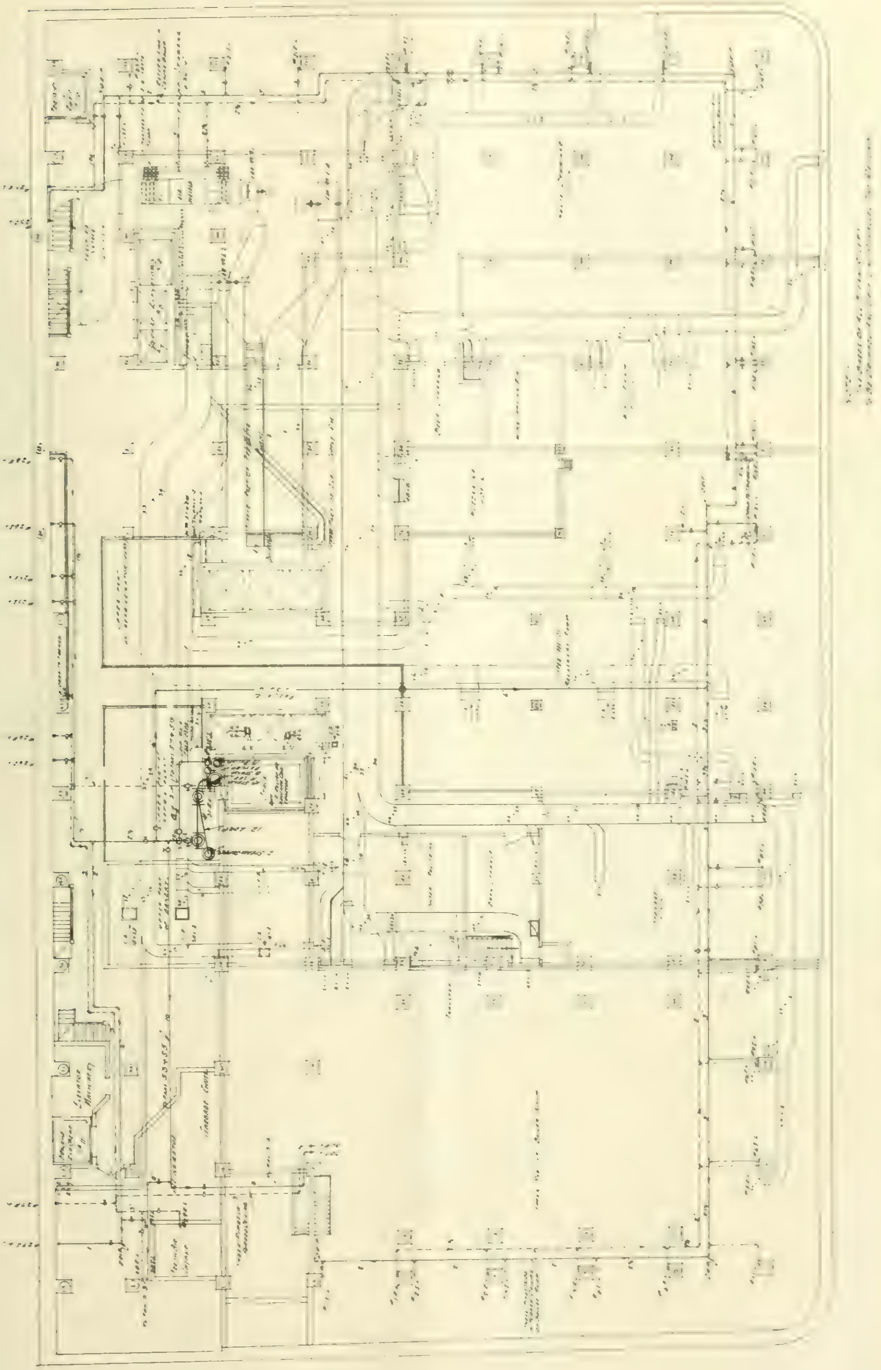
SECTION A-A, MACHINERY ROOM PLAN, SHOWING ARRANGEMENT OF HOT WATER HEATERS.

barber shop, grill kitchen, barber shop and general help quarters. The second level, the first sub-basement, contains wine and beer storage boxes, general hotel storage space and the upper part of the machinery room. The second sub-basement, contains the machinery room, upper part of boiler room and general storage space. The lowest level, about 60 ft. below the street, is the boiler room.

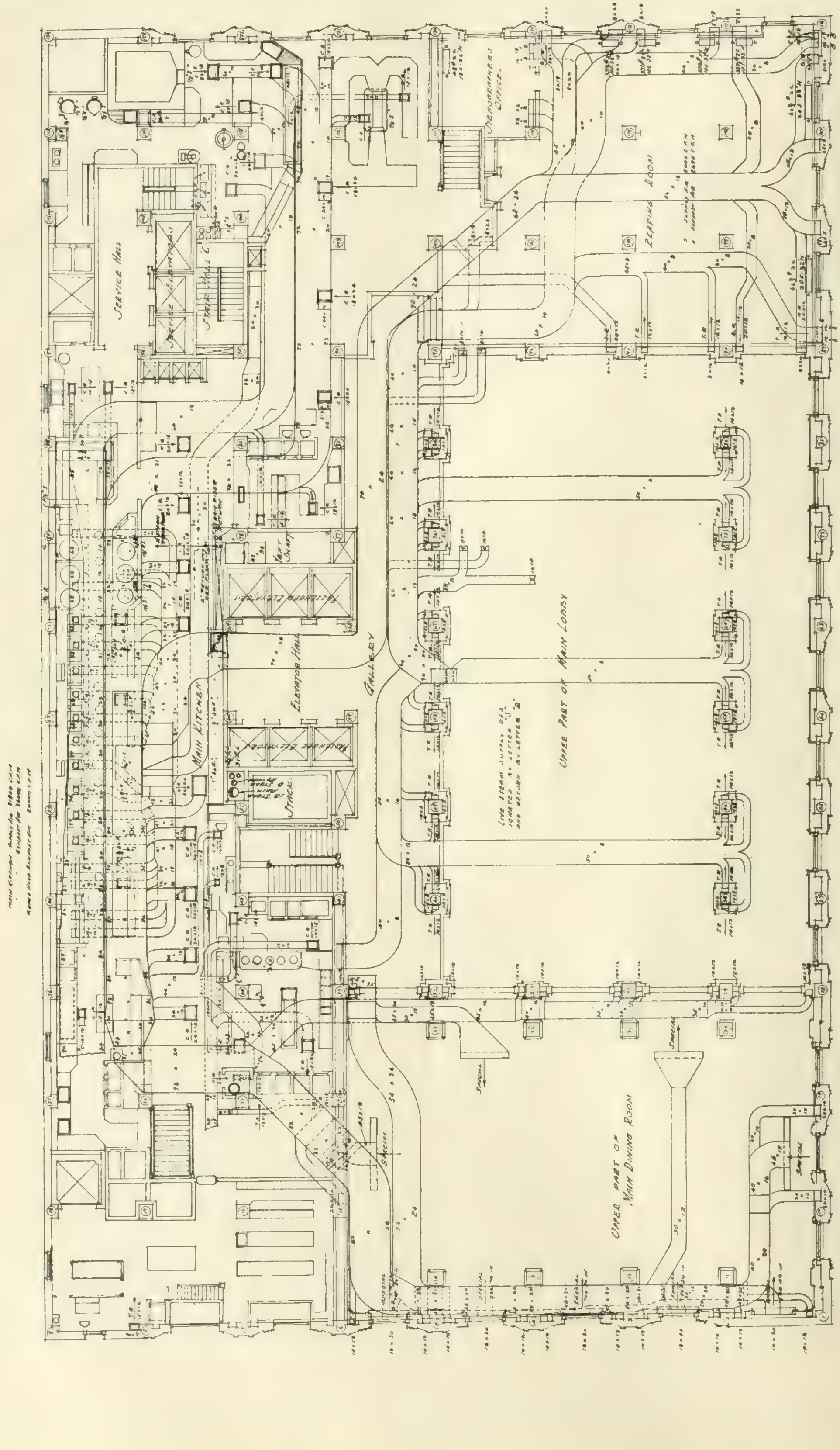
The mechanical plant of the building is unique in that all electrical power services are received from outside sources, and all mechanical equipment is electrically operated. The electrical current is supplied to the building by the Duquesne Light Company and the hotel company has leased to the Duquesne Light Company certain portions of the sub-basement in which they have installed steam generating boilers.



PUMPS, ETC. UNDER HEATER PLATFORM, MACHINERY ROOM.



FANS, DUCTS, ETC., IN FIRST SUB-BASEMENT, WILLIAM PENN HOTEL



VENTILATION FOR MEZZANINE FLOOR AND MAIN KITCHEN, WILLIAM PENN HOTEL.

Low steam pressure is supplied for direct and indirect heating systems and medium pressure steam is supplied for the kitchen equipment. The electrical current for lighting is 220-110 volts A.C. and for power is 240-120 volts D.C.

In the machinery room, in the second sub-basement there are located the electrically-driven centrifugal pumps for the high and low pressure water systems, the suction tanks, the hot water generators for supplying hot water to bathrooms and kitchens, the vacuum return pumps and separators for the vacuum heating system, water filters, cold water and steam condensation meters, drip tanks and ejectors, electrical-driven air compressors, receivers and storage tanks, the vacuum cleaning plant, the ammonia compressors, brine and water coolers, condensers, ice-making tank, ice storage space, ice cubers and crushers, filters for drinking water and water supply to freezing tank and circulating pumps for the brine and drinking water systems.

HEATING AND VENTILATING SYSTEMS

The heating system is of the vacuum type with duplicate, motor-driven vacuum pumps. The heating system is divided into two separate systems, one which serves the lower portion of the building, known as the lower system, and the high system which serves that portion of the building above the lower pipe space.

The high system is of the down-feed type, with supply mains in the pipe space above the fifteenth floor at an elevation of 270 ft. From the machinery room there is carried an 18 in. supply main to this pipe space, at which level it is distributed through loops to the various risers. From these loops there are taken risers which feed the various radiators throughout the ball room, private dining rooms, reception rooms, bed and bath rooms. The return risers for the high system are collected in the lower pipe space at an elevation of 93 ft. and main return riser is run to vacuum pumps in the machinery room.

The low system is of the up-feed type with supply and return mains on the ceiling of the first sub-basement. This system is for all of the public rooms on the lower floors, such as dining rooms, grille, lobby and waiting room, together with the various service quarters. The above systems also serve the various indirect fan stacks throughout the building.

All radiators are of the smooth-section, cast-iron type, with nipples at bottom and top tie rods. Radiators are in general located under windows and are exposed in all cases, except in the main rooms. All radiators in exterior bath rooms are of the same type as those installed in the bedrooms while those in the interior bath rooms are of the wall type. Throughout the main rooms the radiators are enclosed in ornamental grills and are in general provided with thermostat control operated by multiple thermostats.

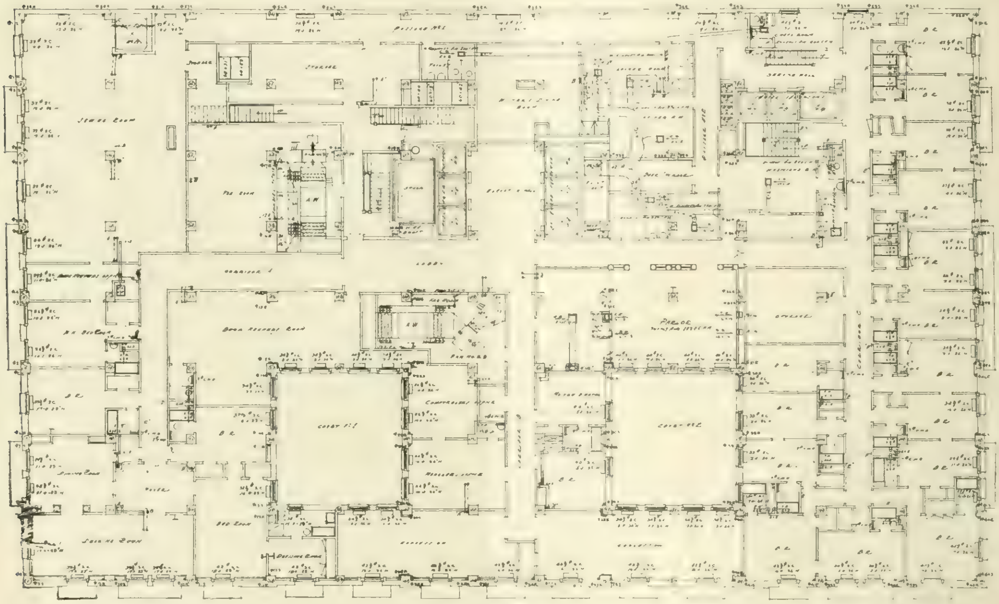
All steam and return piping throughout the building is covered with non-heat-conducting covering, same being recanvased where exposed in finished spaces. Expansion and contraction of piping is taken care of by swings and bends, the expansion loops being in the furred ceiling or pipe chases at exterior walls. The main supply riser is provided with a slip expansion joint. The piping is anchored at suitable points so that all expansion is away from the anchors towards expansion loops or swings. Sleeves have been provided around piping where same pass through walls or floors. Where pipe is exposed in finished rooms escutcheons are placed around same.

Thermostat control is installed on all tempering and reheating stacks of the supply fans, these also being of the multiple type. Adjacent to thermostats, located in ducts, there has been installed mercurial thermometers with perforated stem casing and flange for connection to sheet metal work.

The vacuum valves are of the Haines manufacture and the duplicate vacuum return pumps are of the Nash Engineering Company's manufacture. This is the first building in which a pump of this type and manufacture has been used for vacuum heating purposes. These pumps are provided with the usual automatic vacuum control apparatus, gauge board, air separating tank and strainers.

From the air separating tank there is taken a connection from the bottom of the tank to the water pump and a connection from the top to the air exhausting pump, both pumps being mounted on the same shaft and on a common bedplate with the motor.

The ventilation system is very complete in that all main rooms, kitchens and the various spaces below the street level are supplied with fresh air and have vitiated air exhaust. The bathrooms have no supply, but are provided with exhaust. There are twenty-three Sturtevant motor-driven fans throughout the various floors, eight of which are supply and fifteen exhaust. All supply fans are provided with air washers and range in capacity from 36,000 cu. ft. to 7,000 cu. ft. per minute, with Westinghouse motors ranging from 22 H.P. to 4 H.P. All motors are of the 220 volts D.C. multipole type, shunt wound, with a speed variation of 100% to 50%. The range of exhaust fans is about the same as the supply fans.



LOCATION OF HEATING AND VENTILATING APPARATUS ON PARLOR FLOOR, WILLIAM PENN HOTEL.

Most of the large rooms have their individual supply and exhaust systems and there are individual systems for toilet exhaust, bath room exhaust and range hood exhaust.

The fans are located on various floors throughout the building, being as near as possible to the spaces which they serve. Great care has been taken in the installation of the ventilating system and in the selection of apparatus to eliminate any possibility of noise from the fans, motors or ducts and the telephoning of same throughout the building structure. The total capacity of all fans is very close to 500,000 cu. ft. of air per minute, with a total connected horsepower of approximately 275 H.P. All supply fans have tempering and re-heating stacks the total amount of which is almost 9,200 sq. ft.

The largest single group of fans is in the pent house where there are grouped two supply fans and ten exhaust fans.

The total direct radiation and equivalent indirect throughout the building is approximately 125,000 sq. ft. of surface.

The Duquesne Light Company has leased certain portions of the basements in which they have installed steam generating boilers, using gas for fuel. Steam service is supplied to the hotel company from these boilers at two pressures, a medium pressure for cooking purposes and a low pressure for the heating system. The steam quantities are measured by means of condensation meters located in the basement, which meters discharge into open tanks located in the Duquesne Company's space. These meters measure separately the kitchen, plumbing and heating steam.

REFRIGERATION

There are two electric-driven ammonia compressors of the Triumph Company's manufacture, each having a rating of 50 tons of refrigeration, making a total of 100 tons.

The ice-making tank contains 140 300-lb. cans and the cooling of the brine in the tank is accomplished by direct expansion ammonia coils. The brine circulation throughout the tank is accomplished by motor-driven agitators. Throughout the building there are 57 boxes having a total cubical contents of 30,000 cu. ft., all being brine cooled by galvanized-iron pipe coils.

The brine circulation to the boxes is divided into three systems, one being designated as the high, one as the low and the other as the ice cream system. The low system cools all boxes in the main kitchens and below, the high system cools all boxes in the banquet kitchens and serving pantries.

These circulating systems are of the positive differential type; that is, the mains are looped and the pressure difference between boxes is kept constant. There are, however, several boxes that are shunted across the mains.

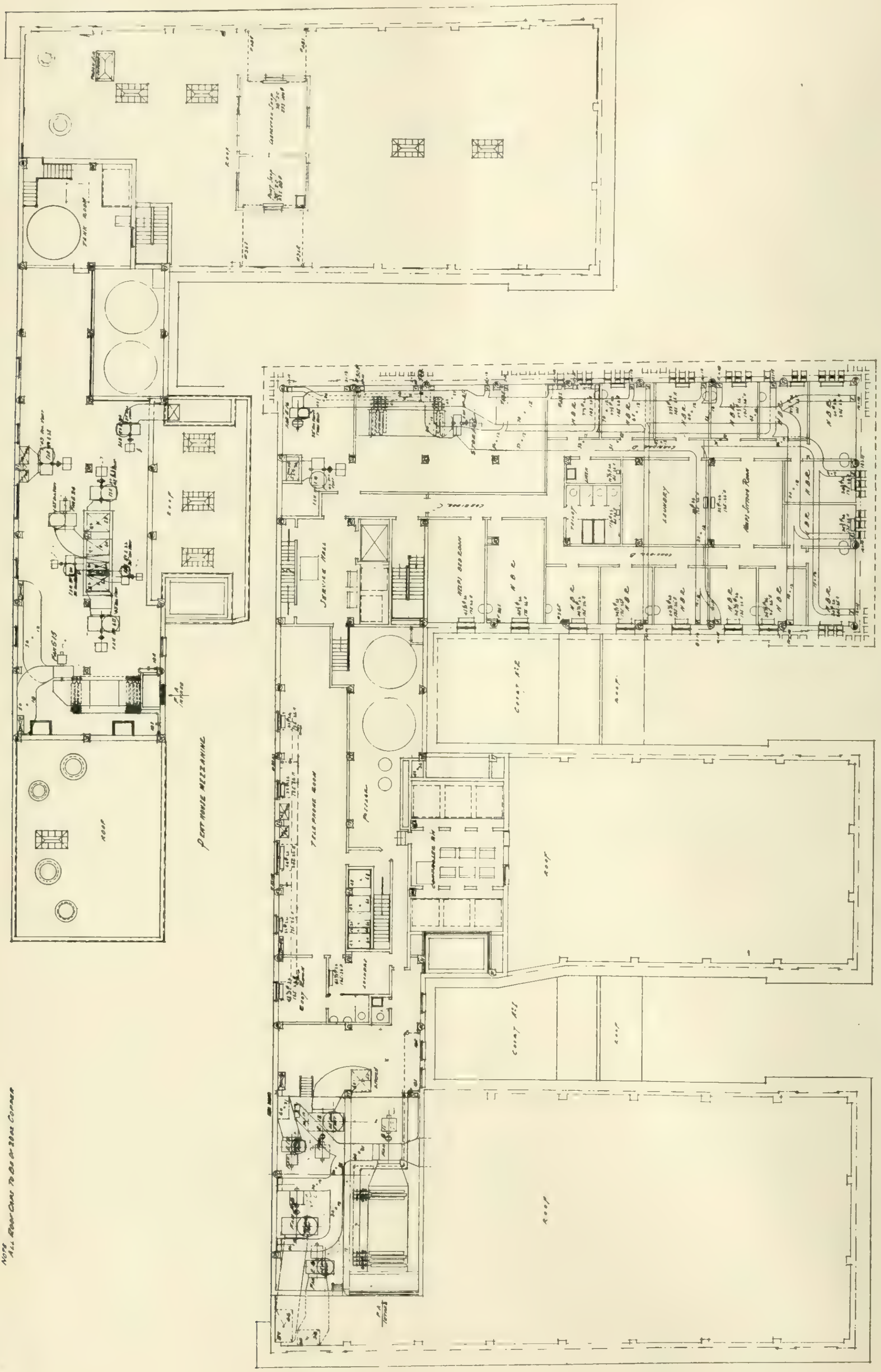
The pumps for the low system are of the centrifugal type, motor-driven. The

SCHEDULE OF FANS, SPEEDS, POWERS, CAPACITIES ETC.

		Static Pressure	Fan No.	Capacity.	Motor H.P.	Speed	Air Washer Capacity	Heaters	Surface	Location
		■		C. F. M.						
						FIRST SUB BASEMENT				
5 S.I.		1"	S-1	7,500	4.	358-179	10000.	T.C. 4 Row 40"-9 Sec. H.C. 3 " 40" 9 " "	270 ϕ 202 S	S.B.S.
S.S.I.		1¼"	E-2	10,000	7.	417-209	NONE	NONE		S.B.E.
8 S.I.		1¼"	E-4	32,500	18.	280-140	" " "	" " "		B.E.
						BASEMENT				
9 S.I.		1½"	S-3	27,500	20.	243-122	30,000.	T.C. 4 Row 2 High 50"-15 Sec. H.C. 3 " " " " " "	988 ϕ 798 ϕ	B.S.
						MEZZANINE				
EQUIVLANT FOR A. B. CO. RATING.	8 S.I.	1¼"	S-5	25,000	1[illegible].	258-129	25,000.	T.C. 4 Row 2 High 40"-14 Sec. H.C. 3 " " " " " "	840 ϕ 630 "	M.K.S.
						PARLOR FLOOR				
	7 S.I.	1"	S-7	12,500	6.	250-125	15,000	T.C. 4 Row 50"-11 Sec. H.C. 3 " " " "	418 ϕ 313 S	M.D.R.S.
								T.C. Top 4 Row 40"-12 Sec. T.C. Bot. " " 50"-12 "	808 ϕ	
	9 S.I.	1¼"	S-9	25,000	16	219-109	25,000.	H.C. Top 3 Row 40"-12 Sec. H.C. Bot. " " 50" 12 "	612 ϕ	M.F.S.
						18TH FLOOR				
	7 S.I.	1½"	E-6	22,000	18.	326-163	NONE	NONE		N.T.E.
	9 S.I.	1"	E-8	36,000	22	219-110	" " "	" " "		BI.R.E.
	6 S.I.	1½"	E-10	17,500	15.	390-195	" " "	" " "		M.D.R.E.
	9 S.I.	1½"	E-12	30,000	22.	244-122	" " "	" " "		M.K.E.
	7 S.I.	1½"	E-14	22,000	18.	326-163	" " "	" " "		S.T.E.
	5 S.I.	1"	E-16	8,500	5.	366-183	" " "	" " "		P.D.R.E.
	9 S.I.	1"	S-11	36,000	22	219-110	40,000	T.C. 4 Row 2 High 40"-20 Sec. H.C. 3 " 2 " 40"-20 "	1200 ϕ 900 "	BI.R.S.
	5 S.I.	1"	S-13	7,000	4.	354-177	10,000	T.C. 4 Row 40"-9 Sec. H.C. 3 " 40" 9 "	270 ϕ 202 S	P.D.R.S.
						PENT HOUSE				
		1"	S-15	12,500	7	305-152		T.C. 4 Row 50"-11 Sec. H.C. 3 " 50"-11 "	418 ϕ 313 S	
7 S.I.		2"	E-18	22,000	18.	363-182	NONE	NONE		
5 S.I.		2"	E-20	10,500	8.	504-252	" " "	" " "		
4 S.I.		2"	E-22	6,650	7.	628-314	" " "	" " "		
7 S.I.		1¼"	E-24	15,000	9.	282-141	" " "	" " "		
7 S.I.		1½"	E-26	22,000	18.	326-163	" " "	" " "		
7 S.I.		1"	E-28	16,500	9.	260-180	" " "	"		
6 S.I.		1½"	E-30	13,500	10.	365-183	" " "	"		
				417150	273					

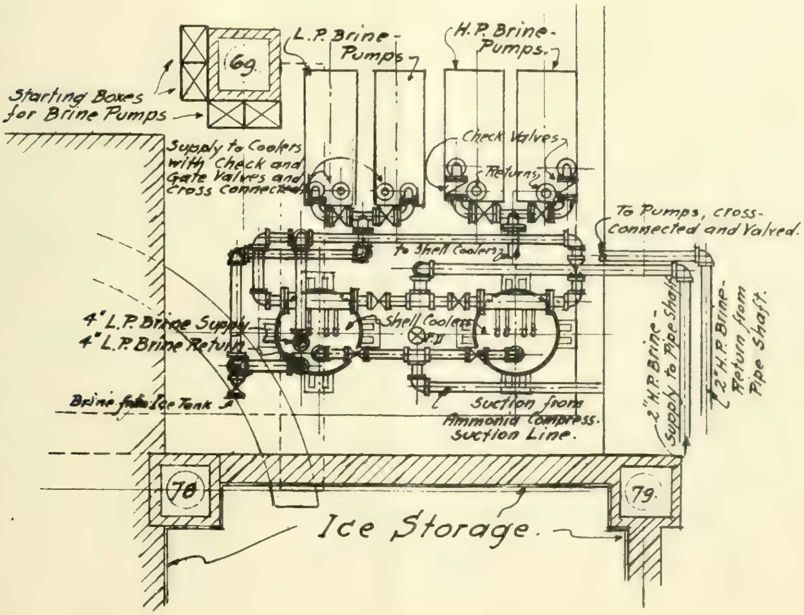
■ PIN HOLE TEST.

ALL VENTO T.C.
SECTIONS 5⅜" C.



ARRANGEMENT OF VENT FANS ON EIGHTEENTH FLOOR AND PENT HOUSE ROOF, WILLIAM PENN HOTEL.

supply main rises from the pumps to the ceiling of the machinery room and is run thereon to a pipe shaft adjacent to the service elevators. At the main floor is located a florist box which is connected directly across the mains. There are no more boxes taken off the supply main, but same discharges into an open balancing tank set on the parlor floor. From this balancing tank the supply main drops to the ceiling of the main kitchen and is looped thereon. The return riser is run parallel to the supply and is looped in the opposite direction. The supply and return branches are taken from these mains through valves to the box coils. After circulating about the main kitchen ceiling, the mains drop in the pipe shaft to the grill room kitchen, the supply main stopping at the last box and the return main returning direct to the brine coolers in the basement. In parallel with the above loops there is also another loop taken from the same balancing tank, which supplies brine to coils in the butcher shop boxes.


L.P. Brine-Pumps
H.P. Brine-Pumps.
69
Starting Boxes for Brine Pumps
Supply to Coolers with Check and Gate Valves and Cross Connections
Check Valves
Returns
To Pumps, cross-connected and Valved.
To Shell Coolers
4" L.P. Brine Supply
4" L.P. Brine Return
Shell Coolers
Brine from Ice Tank
Suction from Ammonia Compress. Suction Line.
2" H.P. Brine-Supply to Pipe Shaft
2" H.P. Brine-Return from Pipe Shaft
78
79
Ice Storage.

PLAN OF SHELL COOLERS AND BRINE CIRCULATING PUMPS.

The operation of the high system is similar to that of the low in that the mains are looped around in the ceiling of the kitchen, but across the vertical risers there are several pantry boxes shunted.

The balancing tank for the high system is located on the eighteenth floor. The high and the low systems are operated through a common, duplicate set of brine coolers, although each system has an individual duplicate set of circulating pumps.

The ice cream freezers and storage boxes are cooled by a separate and individual system having a separate shell cooler and duplicate circulating pumps. The brine is circulated throughout the building to the various ice cream freezers and hardening boxes.

Every bathroom throughout the building is supplied with drinking water. The makeup water is filtered through a bank of Buhring filters and is connected into the circulating line at the drinking water coolers, the circulating return and makeup water passing through these coolers, wherein it is cooled by direct-expansion coils. The drinking water system is of the overhead down-feed type, circulated by duplicate, motor-driven centrifugal pumps. The discharge from these pumps is carried up in the pipe shaft to the eighteenth floor level where is located the balancing tank. The supply main is carried therefrom to the loop located in the furred ceiling of the fifteenth floor. From the high level loop risers are taken down through each bath room shaft and branches therefrom run to drinking water faucets on each lavatory. In the pipe space of the mezzanine floor the circulating return mains are looped, to which loops the circulating lines from all risers above are connected. The returns are carried down through the building to the circulating pumps.

ELEVATORS AND DUMBWAITERS.

The elevator and dumbwaiter equipment consists of six passenger cars, four service cars, one freight car and seven dumbwaiters of Otis make. Two of the service cars have geared machines of the drum type located in the basement. The remainder of the service cars, together with the freight and passenger cars, have overhead machines of the one-to-one traction type. These machines are located in elevator pent houses over the hatchways and are so arranged that there is no perceptible noise in the elevator shafts due to their operation. The pent houses are separated from the elevator shaft by solid concrete slabs.

The elevator cars and machines are of the most modern type and are completely equipped with safety devices. All elevator cars are provided with emergency exits and when two or more cars are located adjacent to each other in the same hatchway, it is possible to pass from one car to the other through these emergency exits.

The dumbwaiter machines are also located over the car shafts and are of the geared, drum type. All dumbwaiters are of the full automatic type, and those for pantry service have their main control point at the main kitchen level. These cars can only be despatched from this level and when arriving at their destination they automatically open the dumbwaiter shaft door. Simultaneously with the opening of the door a buzzer is brought into operation, thus calling the attendants' attention to the car. After removing the contents of the dumbwaiter the attendant closes the shaftway door and the car automatically returns to the main kitchen level. Aside from the initial pressing of the sending button and the closing of the doors by attendants, the operation is automatic. The sending board is also provided with a return button which will stop the car and return it to the sending point if the button is pressed before the car reaches its destination. The object of this is to return the car if the attendant sees that he has made a mistake in the sending.

WATER SYSTEMS.

The house service cold water pumps are of the Alberger centrifugal type, automatically operated by electric tank switches. The cold water system is divided into two sections, the low system which supplies all water to the lower portions of the building through tanks located on the parlor floor, and the high system which supplies water to the bedroom floors and spaces above same through the roof tanks. Adjacent to the house service cold water pumps there is located the fire pump which delivers water to the fire tank in pent house at the roof and from which tank is taken the mains to the various standpipe risers throughout the building. This pump is also automatically controlled by electrical tank switches.

COMPRESSED AIR SYSTEM.

The compressed air for operating the pneumatic tubes, ejectors, heating control and lifts is supplied by duplicate electric-driven automatic Clayton air compressors, each of 350 cu. ft. per minute displacement against 25 lbs. per square inch pressure.

These machines start and stop with a slight variation of air pressure in the storage tank. From this tank the air is distributed to various points of usage about the hotel.

The entire mechanical equipment was designed and supervised by Clyde R. Place, New York, consulting engineer for the architects, Janssen & Abbott. The heating and ventilating systems were installed by F. E. Geisler, sub-contractor of the general contractors, the George A. Fuller Company, New York

Relative Economy of Heating by Steam at Different Pressures.

By A. BEMENT

Recently in Chicago there has been occasion to examine the matter of cost of heating with steam at atmospheric pressure, as against 3 to 5 lbs. pressure, in modern office building plants. It is felt that your readers may be interested in the results of a study of the subject.

When the question was presented, the opinion of a number of engineers was sought, four of whom said that there was no difference in the amount of heat required and consequently no difference in cost. Two said that the difference was so small that it could not be detected by the most elaborate test, as the necessary error of observation is larger than any possible difference. Another gave as his opinion that there was a very large difference.

In an analysis of the problem, a heating requirement of 5,000 B.T.U. per hour was taken, a pressure of 5.3 lbs. being used to compare with atmosphere, as the figures applying to the characteristics of steam in Kent's Pocket Book are given for these pressures and may be verified accordingly. The following table gives the data.

In operation steam enters the radiator and gives up its latent heat (item 2 of the table). It is this heat that does the work of warming. The condensation, which is at the same temperature as the steam when it entered, as per items 4 and 5, returns to the boiler, carrying all of the original heat of the steam not used for warming. Thus the heat returning to the boiler is again

Item	*Pressures*	
	Atmosphere	*5.3 Lbs.*
1. B.T.U. in the water below boiling point, in one pound of steam	180.0	196.1
2. Latent heat in one pound of steam, in B.T.U.	970.4	960.1
3. Total heat in one pound of steam in B.T.U.	1150.4	1156.2
4. Temperature of the steam, deg. F.	212.0	228.0
5. Temperature of the water of condensation, deg. F.	212.0	228.0
6. Volume in cubic feet of 1 lb. of steam	26.79	20.08
7. Heating requirement, in B.T.U. per hour	5,000	5,000
8. Pounds of steam required per hour (heating requirement divided by the latent heat of one pound of steam)	5.152	5.207
9. Total B.T.U. per cubic foot (B.T.U. per pound divided by cubic feet)	42.98	57.98
10. B.T.U. available for heating per cubic foot of steam (latent heat divided by cubic feet in one pound	36.9	47.8
11. Cubic feet of steam required to furnish the heating requirement of 5,000 B.T.U. per hour (5,000 divided by item 10)	135.5	104.6
12. Relative volume of piping and radiators required with same velocity in movement of steam, assuming 5.3 lbs. pressure as unity	1.29	1.00
13. B.T.U. delivered per hour from each square foot of radiating surface, with air temperature at 70° F...	234	260
14. Square feet of radiating surface required (heating requirement of 5,000 B.T.U. divided by B.T.U. delivered per square foot of radiating surface per hour	21.36	19.23
15. Time in minutes required to deliver 5,000 B.T.U. from		

circulated without loss. The following heat balance shows that the low pressure steam gives up about 1% more heat than the 5.3 lb. pressure:

HEAT BALANCE IN B.T.U. PER POUND.

	Pressures	
	Atmosphere	5.3 *Lbs.*
B.T.U. used in heating	970.4	960.1
B.T.U. recovered in the water of condensation and returned to the boiler for re-use without loss	180.0	196.1
Total B.T.U. accounted for	1150.4	1156.2
B.T.U. supplied in the steam (item 3)	1150.4	1156.2

HEAT BALANCE IN PER CENT.

B.T.U. employed in warming	84.35	83.04
B.T.U. returned to the boiler for re-use	15.65	16.96
Total heat accounted for, B.T.U.	100.00	100.00

This, however, does not mean that there is such a difference in economy because this lesser amount of heat given up by the pressure condition, returns to the boiler for re-use, and the disadvantage is that 1% of the heat in a pound is carried around the cycle without doing work. This view, however, is based on the consideration of steam from the standpoint of its weight, but steam is a gas and gases are generally dealt with in volumes. If, then, the matter is considered in this light the following comparison presents a different view:

COMPARISON ON B.T.U. IN A CUBIC FOOT BASIS.

	Pressures	
	Atmosphere	5.3 *Lbs.*
B.T.U. per cubic foot expended in heating (item 9, multiplied by first item of the heat balance, in per cent).	32.24	48.15
B.T.U. per cubic foot not used in heating but which is returned to the boiler for re-use (difference between items 9 and item above)	10.74	9.83
Total B.T.U.	42.98	57.98

COMPARISON IN PER CENT, BASED ON HEAT IN A CUBIC FOOT.

Used in warming, B.T.U.	75.01	83.04
Returned to the boiler for re-use, B.T.U.	24.99	16.96
Total B.T.U.	100.00	100.00

This shows that at atmosphere we must carry around the cycle from boiler back again to boiler 8.03% of the total steam at atmosphere more than at 5.3 lbs. pressure; or, in other words, we must use a larger volume of steam at atmosphere by 8.03% to do the same work than if circulated at 5.3 lbs. pressure. The volume of steam as the pressure is lower increases much more rapidly than does the latent heat as shown by the table on next page.

This shows that to operate at 5 lbs. below atmesphere would require risers and piping of almost twice the capacity of those needed for 5 lbs. above atmosphere; more radiating surface would also be needed.

	Per Pound of Steam		
	Latent Heat B.T.U.	Total Heat B.T.U.	Cubic Feet
10.3 Lbs. above atmosphere	952.0	1160.4	16.30
5.3 " " "	960.0	1156.2	20.08
0.0 " " "	970.4	1150.4	26.79
5.0 " below "	982.0	1143.1	38.38
10.0 " " "	1000.3	1130.5	73.33
15.0 " " "	1073.4	1073.4	3294.00

When the matter is summed up, it appears that on the basis of heat in a *pound* of steam the atmosphere pressure has a theoretical advantage in higher latent heat of about one and a third per cent over 5.3 lbs. pressure. This, however, is off-set by the fact that all heat not used is returned for re-use, and there is no disadvantage in this because in each case there is a pound of condensation returned, being simply a little hotter in one case than in the other, so it requires just that much less heat to bring it to steam again.

According to this, there is no difference whatever in cost of heating at different pressures. There is, however, an advantage in the higher pressure from the standpoint of first cost of the plant, because as the pressure is greater, the plant may be smaller. This is a factor which in practice has a limited value, however, unless excessive pressures are used.

Any plant designed to work at 5 lbs. should have margin enough to work perfectly at atmosphere, and any plant designed to work at atmosphere will operate at 5 lbs. with ease and the cost of heating will be identical in each case.

Standard Data Sheets on Heating and Ventilation.

As announced last month, there is presented in this issue the first of a series of data sheets which it is proposed to develop eventually into a standard heating engineers' data book.

It is the present plan to include with each issue three or four standard-size data sheets containing practical information for the designer. The complete series will run into several hundred sheets and will aim to provide all the required designing information for the laying out of any system. After the sheets have been presented in The Heating and Ventilating Magazine they will be reprinted separately, so that any missing or worn-out sheets may be obtained at the nominal charge of five cents each.

It will be noticed that the data sheets are arranged with a binding strip on the left hand end, so that they may be readily incorporated in a loose-leaf binder. They also have a cutting line so that, if desired, the binding strip may be trimmed off and a sheet 8-in. by 5-in. produced, which is a standard size for card index filing in a drawer or card tray with guides.

By preserving these sheets our readers may expect to have, in a short time, a really first-class condensed encyclopedia to which reference can be made quickly for all necessary information on the art of heating and ventilation. To this end every reader is asked to constitute himself a judge and critic and to scan carefully the data presented, notifying the publishers at once of any errors or discrepancies discovered. These will be submitted at once to expert opinion and, where necessary, new sheets published to take the place of those found incorrect.

Finally, arrangements have been made for supplying readers of The Heating and Ventilating Magazine with suitable binders to contain the data sheets exclusively. Further announcement regarding these binders will be made next month. They will be made up with special reference to their appearance and durability, bound in duck, and stamped in gold. These binders will be supplied at $1.00 each. They will be ready March 1, but orders may be sent in previous to that time and will receive careful attention.

THE HEATING AND VENTILATING MAGAZINE
A Monthly Journal of Engineering Progress

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IT IS with great satisfaction that we record a widespread and unqualified approval of our plan, announced last month, for the development of standard heating data, through the publication of the most approved tables and practice that we are able to obtain. The first series of these sheets appears on another page of this issue and, in passing, our readers are reminded once more (1) that the data are not in any sense final, but are open to modification after, but only after, we are in possession of more approved data; (2) that the whole success of the plan depends largely on the active and serious co-operation of every heating engineer through careful scrutiny of the data presented and notification of errors or improper statements. It is not expected for a moment that the information as presented will be at once accepted as standard. No doubt there will be many varying opinions as to its accuracy. It is almost impossible to get engineers to agree about such matters and that, by the way, is the reason why heating standards have not been developed long ago. But we do expect that the data will be accepted as equal to anything else extant and, by modifying the sheets where necessary, it will be possible to secure a serviceable and standard code.

The vital interest in this matter on the part of the engineering associations is well expressed in a recent letter received from the president of the National District Heating Association. He writes: "I read your editorial (regarding the publication of standard heating data) with a great deal of interest and want to express my hope that you will be able to get something definite along the line of heat loss co-efficients. If there is anything this Association can do to assist you in developing this standard, we would be very glad to co-operate. Please feel free to call upon the officers for any assistance you deem advisable."

Such a spirit, we believe, insures tangible results and we may say at this time that the plans for publication of heating data sheets have already expanded to the point of including important central station heating information such as rates, appraisal of heating property, costs and depreciation, as well as strictly engineering matter. The same thing applies to the schedule of heating data for it is the intention to have the sheets comprise as complete a handbook as possible.

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IN COMPANY with the majority of publishers throughout the country we are obliged to ask the indulgence of our readers in connection with the paper stock used in THE HEATING AND VENTILATING MAGAZINE. As is well known, publishers are finding it quite impossible at the present time to obtain the desired quality, even at a higher cost. It is hoped, however, that this condition is only temporary.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Twenty-third Annual Meeting, New York, January 16-18, 1917

Almost every meeting of The American Society of Heating and Ventilating Engineers brings out some development in engineering work that has not previously attracted general attention. This year it was the possibilities of industrial drying, including the use of gas heaters for this purpose. Fred R. Still, of Detroit, sounded the keynote when he told of the tremendous possibilities in this direction, both in the United States and abroad. In the matter of drying hides, for instance, it is only recently that the time-honored practice of stretching them in lofts, exposed only to the action of the weather, has given place to mechanical drying methods, effecting savings of thousands of dollars in time and trouble. This, Mr. Still showed, was equally true of an endless variety of products, such as paper, cardboard, paints, oils, pigments, chalk, varnishes, clay and wood products.

J. IRVINE LYLE,
President, American Society of Heating and Ventilating Engineers.

Another feature of the meeting was the revival of the project to establish a code for testing house heating boilers. Although little progress was made at the meeting, it begins to look as if the movement has gained sufficient headway to bring the development of such a code among the probabilities of the near future.

The society met at the Engineering Societies Building, 29 West 39th Street, New York, January 16-18, 1917. It was not the largest turnout of the society's meetings, but the attendance was good and the discussions were full and sometimes lively. A total of 143 members, 56 guests and 25 ladies was registered.

Due to a combination of circumstances, the society had the good fortune to secure the large assembly room of the Engineering Societies Building for its meeting.

The opening session was called to order by President Harry M. Hart. He announced that F. K. Davis, J. E. Deegan and W. M. Van Inwagen would serve as tellers for the election of officers. He then presented his annual address.

PRESIDENT'S ADDRESS.

Mr. Hart said that the great need of the society is for closer co-operation and for progress in the field of standardization. He said we are facing abnormal conditions in the industrial world, and one important effect on the heating trade has been the rapid growth in the development of heating and ventilating designs applicable to manufacturing processes. The reticence on the part of engineers to discuss their methods has been a drawback and it is becoming more necessary than ever for a close and unrestrained co-operation.

We need standard practice for heating installations in apartments and residences and such standards have already been adopted by the Chicago Master Steam Fitters' Association. Not over 10% of such buildings, said Mr. Hart, can be heated to 70° when it is 10° below zero outside. He also stated that the pipe sizes proposed by a committee of the society in 1908 had been adopted by the Chicago master steam fitters for use in their work.

President Hart made the interesting announcement that the Chicago Commission on Ventilation has recently secured an appropriation from the city for furthering its work and this will enable the commission to make some important investigations in addition to those already undertaken. Three members of the society, he said, are now members of this commission.

This was followed by the report of the Council. This report gave the principal credit for the growth of the society to the Chapters and placed special emphasis on the work in this direction of the Michigan and New York Chapters. The council reported that the Bureau of Mines had invited the society to hold its next midsummer meeting in Pittsburgh in September at which time the dedication of the Bureau's new testing plant will take place. The council had, however, practically decided on Chicago as the next meeting place, but has arranged to be represented at the dedication ceremonies in Pittsburgh.

The agitation for compulsory ventilation laws in a number of western States was reported by the council, although no additions had actually been made to the existing laws on this subject.

Reference was made to the matter of Chapter representation in the council and this came up for further discussion later in the form of a proposed amendment to the constitution providing for such representation. No action, however, was taken in this matter.

Additional quarters, it was stated, had been secured in the Engineering Societies Building for storage purposes of society records, giving more room in the headquarters office.

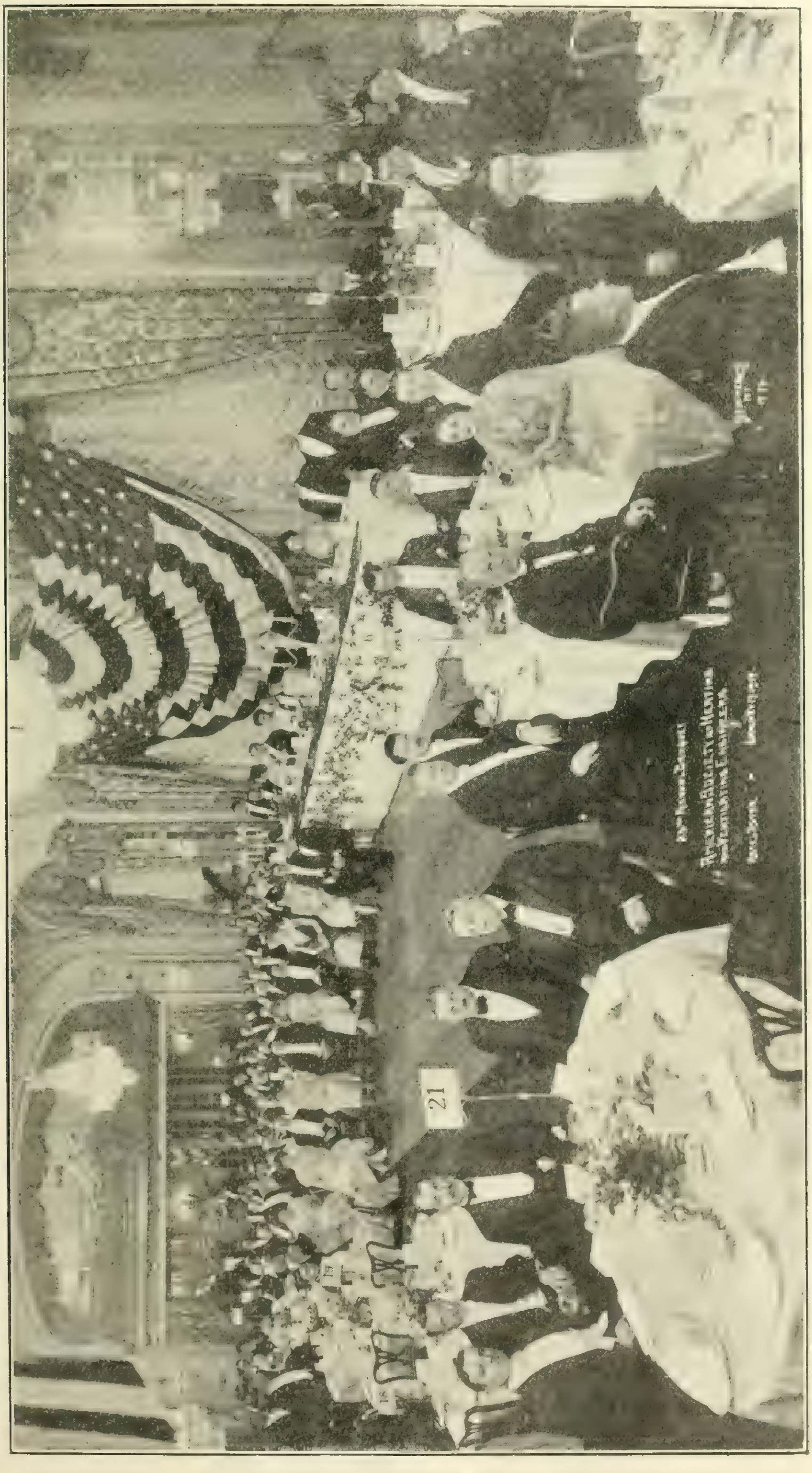
Finally the council reported a new design for the society emblem which would shortly be ready for adoption.

Secretary C. W. Obert presented his annual report. He said the present membership totaled nearly 750. Some idea of the increase in the duties of the secretary's office was given in his statement of the division of the work. He showed, for instance, that the names of prospective members were being regularly listed and efforts made to bring the advantages of membership to their attention.

He stated that an index of the twenty-one volumes of the Transactions was being prepared for 10-year periods and would be issued early in the year.

The financial status of the society was reported to be the best in its history. The total receipts for the year, together with last year's balance, were $12,141 and the total expenses, $8,136, leaving a balance on hand of $4,004. The net assets were given as $13,526. The total membership at the beginning of the year was 626 and the accessions for the year, 125, making a total of 751. There was a loss of eight members during the year leaving a net membership of 739.

Under committee reports, a recommendation was made by the Committee on Local Secretaries that a local secretary be appointed in each locality where there is at present no society chapter. The functions of these officials will be to keep track of pending legislation on heating and ventilating matters, to secure news and other items for the society's Journal, to look up the qualifications of



ANNUAL DINNER OF THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, HOTEL ASTOR, NEW YORK, JANUARY 17, 1917.

prospective members, and to carry out any particular directions of the council. This matter was referred to the council, with a recommendation for favorable action.

For the Committee on Radiator Tests Prof. John R. Allen stated that a series of tests was now under way and that the committee expected to make a definite report at the next semi-annual meeting.

CHAPTER REPRESENTATION IN COUNCIL PROPOSED.

Under new business an amendment was proposed by J. D. Cassell, John R. Allen, W. F. Goodnow and Frank E. Phegley, giving each chapter the privilege of naming one of its members as a member of the society's council. As there are now six chapters, this would enlarge the council by that number.

Mr. Donnelly brought up the point that there would be legal difficulties in the way of carrying out this suggestion, as the society is an incorporated body.

It was then suggested that a chapter could nominate a member of the council and the membership could elect him.

Prof. William Kent said that the Institute of Mining Engineers had district representation on its council and that he thought the proposed amendment should be redrawn to meet the provisions of the law.

It was then suggested that if the chapter representatives had no vote it would solve the difficulty.

The matter was referred back to the proposers to be redrawn to meet the legal requirements. Pending any change in the constitution it was voted that a copy of the call and the minutes of each council meeting be sent to the various chapter presidents.

KANSAS CITY CHAPTER.

A petition was then presented from Kansas City members asking for the granting of permission to form a Kansas City Chapter. The petition was signed by Herbert H. Whitten, Prof. J. D. Hoffman, F. A. De Boos, Benjamin Natkin and a number of others. Although the council had approved the formation of this chapter it was left to the meeting to take definite action. After Mr. Natkin had explained the steps that led up to the formation of the chapter, the necessary permission was granted by unanimous vote.

NEW OFFICERS.

The report of the tellers was received showing the election of the following officers:

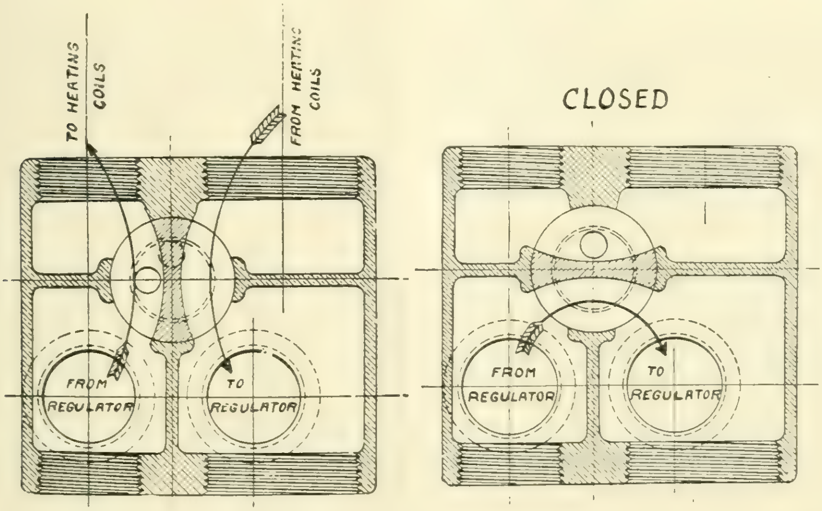
President, J. Irvine Lyle, New York; first vice-president, Arthur K. Ohmes, New York; second vice-president, Fred R. Still, Detroit, Mich.; treasurer, Homer Addams, New York; members of the council, Davis S. Boyden, Boston, Mass.; Bert C. Davis, Elmira, N. Y.; M. W. Franklin, East Orange, N. J.; Charles A. Fuller, New York; Harry M. Hart, Chicago, Ill.; E. Vernon Hill, Chicago, Ill.; James M. Stannard, Chicago, Ill.; Walter S. Timmis, New York.

The election of officers brought the business session to a close and the first paper on the professional programme was then presented. This was entitled "Railway Passenger Car Heating," by E. W. Rietz.

Railway Passenger Car Heating.

Mr. Rietz's paper was devoted largely to a description and discussion of the vapor system of car heating which, he said, is used on a majority of the railroads of the country and by the Pullman Company. The first method of heating railway trains was by the use of ordinary wood-burning stoves. These gave way to the hot water heater, known as the Pullman or Baker heater. With this system the heater or stove was placed in the end of the car in a small compartment. The water circulation was usually taken care of by placing four 1¼-in. pipes on each side of the car. The objections were that it took an hour to get up a good fire and a good circulation in the car and an equally long time to cool off. Next came what the speaker called the "straight pressure" system, in which the steam was drawn direct from the locomotive. A large number of freeze-ups were experienced with this system, as well as the overheating of the forward cars. In the vapor system, now in wide use, the steam is taken from the locomotive. It is passed through a reducing valve and thence into the train line which is usually of 2-in. pipe. All train pipe valves in the entire train must be open. When steam appears at the rear of the train, it is allowed to blow for a few minutes until dry steam shows. The rear valve is then shut and immediately opened a little for "bleeding," and to prevent freezing. The vapor system is composed of three units: the vapor regulator, the cut-out steam heat valves and the heating coils or pipe. Mr. Rietz gave a detailed explanation, with illustrations, of these devices as developed by the Chicago Car Heating Company. The vapor regulator acts to receive steam from the train line at its pressure and corresponding temperature and convert it into steam or vapor under no pressure before it passes into the heating pipes inside of the car. The vapor cut-out valve controls the admission of heat to the radiating pipes by directing the flow of atmospheric pressure steam and, when desired, short-circuiting the steam, thus cutting off the heat in any particular car. The paper was accompanied by diagrams of arrangements of this system in four types of Pullman coaches. There was also included a table showing the number of feet of pipe required per foot of car length.

Mr. Hart said that the use of thermostats in railroad coaches was greatly to be desired, as it is no uncommon experience to find excessive temperatures, especially in sleeping cars.



OPEN AND CLOSED POSITIONS OF THE VAPOR CUT-OUT VALVE FOR RAILWAY CAR HEATING.

F. K. Davis suggested individual heat control for every seat, and said that, even with 20 or 26 valves it would be an insignificant item when the average cost of $20,000 per car is considered.

J. H. Davis said the system described was a great improvement over the old Baker system. Mr. Hart called attention to the unique features of the four-way valve used with this system whereby steam was by-passed to the steam traps when not on the system thus preventing the traps from freezing.

Mr. Ohmes thought the method outlined in the paper marked a distinct advance in the method of heating railroad coaches, and when it is considered that such cars are likely to be operated in varying climates from the extreme north to Florida, he thought the system as outlined to be as good as could be expected.

A vote of thanks was voted to Mr. Rietz for his paper.

Evening Session, January 16.

The opening paper at the evening session was entitled, "Some Notes on Warm Air Furnace Heating," by Jesse M. McHenry.

BOILER TESTING SESSION.

One of the principal items on the programme was then taken up, being the report of a committee appointed by the New York Chapter to consider a standard method for testing heating boilers.

The subject was introduced by Homer Addams who recounted the steps previously taken by the society. He felt that the efforts to rate boilers, as well as to test them, had been largely responsible for the shelving of the project in the past.

Mr. Addams urged the appointment of a permanent committee to devise a suitable testing code and to keep at work on it until it is perfected.

Percival H. Seward then presented the committee's report.

The report stated that the specific object of the test which the committee had in mind was the determination of the amount of steam which a boiler will furnish when burning a definite quantity of coal per hour in the manner for which it was designed. Therefore, the schedule (which accompanied the report) covering report of test, provided only for those items which the committee considered essential to determine the proper capacity of the boiler for commercial or sales purposes.

The duration of a general test, went on the report, should be 12 hrs. of constant running. Anthracite coal, stove size, such as Lehigh Valley, was recommended as the proper fuel to be used.

The recommendations made by a similar committee to the society in 1913 were concurred in and reiterated. These included the items of apparatus and instruments, and rules for conducting evaporative tests. One of the recommendations of the new committee was that tests be made at atmospheric pressure. The committee did not advocate the "running start" in use at many boiler plants. Rules were also given for stopping the test and weighing the unburned fuel.

The formula given by the 1913 committee for calculating the rating were included in the report in a modified form and endorsed, as follows:

Let C represent the pounds of fuel available for one firing period. Let T represent the time fuel available will last. Let E equal the total B.T.U. considered available per pound of fuel at boiler outlet, not exceeding results shown by tests.

Then $\frac{C \times E}{T}$ represents the boiler capacity per hour in B.T.U.

If rating is desired in equivalent square feet direct radiation, divide capacity in B.T.U. by 250 for steam and 150 for hot water.

The committee suggested that the report be placed in the hands of a special code committee for complete and final tabulation with due reference to the points brought out in the discussion.

The report was accompanied by a form for "report of test," including some 58 items.

This report brought on an animated discussion between many of the members as to the desirability of certain features together with the practicability of making such a code a standard.

Prof. Allen heartily endorsed the project, but suggested a longer testing period, than 12 hours, or, better yet, a multiple of the firing period of 8 hours (which would be 16 or 24 hours) urging that the error in a 24-hour test would be much less than with 8 or even 12 hours. He farther suggested that anthracite coal is rapidly going out of use, especially in larger installations, and recommended that the testing standard should be made flexible enough to take into consideration firing with bituminous coal. He approved the running of the boiler at atmospheric pressure during the test but recommended the "running start" rather than the method prescribed in the committees' report. He desired to have 4 or 5 hours' operation of the boiler under full steaming conditions before starting the test and believed that the use of recording instruments should be carried out as far as possible. Also that the sample of flue gases should be obtained as a continuous sample rather than only at certain periods and questioned if it would not be difficult to determine the amount of unburned coal at the completion of a test.

Mr. McIntyre advocated 8-hour firing principally on account of the rating for most heating boilers being now made on this basis. He also agreed with Prof. Allen that the standard should cover soft coal, that a running start would be better and preferred a longer test for bituminous coal. He, too, thought it would be difficult to determine the amount of coal in the ashes at the finish of the test and suggested assuming a B.T.U. value of all coal and then a correction of the test readings later from an analysis of the coal. He claimed that the combustion of bituminous coal could easily be carried over 10 lbs. per square foot of grate with good results and recommended 20 readings per hour as well as weighing the residue to determine the amount of coal not burned. He stated that the fire bed might in some cases be more than 20 in. deep and that with bituminous coal greater efficiency is often obtained with the fire bed of greater depth.

Mr. Ohmes presented boiler charts and stated that two curves (which any manufacturer could plot) would be entirely sufficient to show any consulting engineer all that was necessary in regard to the boiler. These two curves consisted of an efficiency curve at various ratings and a curve of loads for various firing periods. He claimed that the most satisfactory boiler is the one which gives the highest efficiency at about 55% of its rating.

Mr. Donnelly suggested that the code be extended to include down-draft and magazine boilers.

Mr. Davis suggested that the subject be approached both from the manufacturers' viewpoint and that of the consulting engineers, and suggested that the principal object of testing a boiler was to see if the client was getting what he paid for. He recommended that the coal be specified as containing not less than a certain number of B.T.U., that the draft be limited to a maximum and minimum, that a surface blow-off be added to the washing out operation of cleaning the boiler, that a separator of given efficiency be used and that the test period should be extended to more than 12 hours.

Prof. Kent stated that the volatile matter which was given off by the unburned coal at the end of a given test would make the result doubtful and suggested burning down so as to leave just enough coal to start a new fire at the beginning of the test and then to stop firing so as to burn down to the same point at the conclusion. He also recommended a 16 to 24-hour run, a combustion rate of 4 lbs. per square foot and then a farther test at other rates of 2, 4, 6 and 8 lbs. pressure.

Prof. Allen brought up the point that on double-grate boilers a running start was a necessity.

Mr. Addams, the chairman of the committee, then explained that the committee assumed of course that there would be draft enough to burn the coal and that the coal would be of general average B.T.U. and moved that a permanent committee be appointed to perfect the standard of tests.

WORK ON BOILER TESTING CODE TO CONTINUE.

After much discussion regarding the membership of the committee it was finally decided to have it consist of nine members of which not more than four were to be connected with the manufacture of heating equipment. It was then voted to have the council appoint such a committee.

In conclusion Mr. Seward, who read the committee's report, explained that all of the points raised were of minor character to the main fact that a standard was desirable. He said that the committee had no objection to a 24-hour test or to the making of it with bituminous coal (or even wood), that rates of combustion could be made 5 to 10 or 3 to 12 lbs. as desired. He said a vote could be taken by the committee on the question of the "running start and "standing start." He agreed to self-recording instruments, continuous samples of flue gas, to the burning out of the unburned coal, to the stating of the

B.T.U. value of the coal, to a 24-in. depth of fire and to the preparation of efficiency charts, but he did not think that 4 lbs. of coal per sq. ft. per hour was practical

Morning Session, January 17.

The first paper at the Wednesday morning session was entitled, "Some Thoughts on the Durability of Materials Conveying Steam, Air and Water," by a member.

Some Thoughts on the Durability of Materials Conveying Steam, Air and Water.

In introducing his subject, which relates to the life of heating plants, the author cited the case of the Bankers Trust Company, at Wall and Nassau Streets, which was occupied in 1880 by the Manhattan Trust Building, in 1897 by the Gillander Building, and now by the Bankers Trust Building. As the cost of an apparatus is directly related to its durability, it is important to know how durable an apparatus is justified in any particular case. He then presented figures showing that the more expensive apparatus, if durable, would still be considerably cheaper after a period of 40 years, than the less expensive apparatus, if not durable.

The author went on to discuss outside corrosion and inside corrosion. His principal conclusion as to outside corrosion was that pipe laying in trenches or in conduits in the ground must be kept dry by proper underdrains. As to inside corrosion he stated that the only corrosion that takes place in a hot water heating system is in the vapor pipe from the expansion tank and in the expansion tank itself. On a domestic hot water supply line, however, he instanced a case where the pipe gave out after two years' service, due to improper aeration of the pipe system. Regarding steam heating systems, he stated that it is assumed and is pretty well established that steam does not corrode the piping, which is mainly due to the entire absence of free air in the steam.

Return pipes, said the author, constitute a problem the ultimate solution of which, perhaps, is to use ordinary steel or wrought-iron pipes for the steam lines, with a possibility of steam-driven pumps or even to use an occasional oil injection for the protection of the surfaces, and then reduce the return pipes to the minimum, but make them of brass or copper, with cast-iron fittings. The author also spoke of pipes carrying air and cited cases where condensation in such pipes had corroded the pipe.

The author concluded by stating that the use of cast-iron, due to its great corrosion-resisting qualities, is becoming daily of greater importance to heating engineers, for fittings, radiators, tempering coils and boilers. He strongly suggested that many pipe lines could be made of cast-iron, because simple flange joints could be used, and, he added, even threaded joints might be developed.

F. N. Speller called attention to the fact that it is not the water itself that causes corrosion, but the impurities carried by the water. Regarding the use of cast-iron, he said one of the principal difficulties was the impossibility of threading cast-iron pipe.

Mr. Otis said that in his experience a heating plant in the average office building will not last over twenty years.

Mr. Blackmore said that high temperature of the water will tend to corrode the pipes. This, he said, was not due simply to the high temperature of the water but to the high temperature of the air particles in the water.

Mr. Weinshank cited a case where the brass pipe gave out while the steel and wrought-iron pipe was not affected. This it was found, was due to the presence of sulphuric acid gas in the water. By pumping the water first to an open tank the trouble was remedied.

Mr. Nichols said that all of the pipes in the State Educational building in Albany were giving out, although installed only three years ago. This was found to be due to the presence of CO_2 in the water after passing through the sand filters, due to the decomposition of microbic substances.

When hard water is used, the pipes are often found filled with a flinty substance.

Pending further discussion, F. N. Speller presented his paper on a similar topic, being "A Method for Practical Elimination of Corrosion in Hot Water Supply Pipe."

A Method for Practical Elimination of Corrosion in Hot Water Supply Pipe.

Mr. Speller's paper was the continuation of a previous discussion of the subject in which he demonstrated that free oxygen and carbonic acid in water are the causes of practically all the trouble with hot water supply lines, as these gases are retained in the water with closed systems of heating. Two methods of removing these gases from water were described, with diagrams giving the percentage removed under various conditions. These were (1) by reducing the pressure of the heated water, as by the use of an "open" type heater under atmospheric pressure, or partial vacuum, or (2) by keeping the hot water in contact with a large surface of iron under pressure for a sufficient length of time to remove and "fix" the oxygen and carbon dioxide.

The latter principle has been in use at two plants during the past year, one of which is the Irene Kaufmann Settlement, in Pittsburgh. Mr. Speller then described at length the system of water treatment at this plant. The results showed that the average oxygen content of the water before treatment was about 8 c.c. per liter and, after treatment, 0.5 c.c. per liter.

A corrosion test was made in these pipe lines at the same time. The results showed that the pipes carrying deoxidized water were in use a month longer and carried 50% more water than other lines, but showed from 62% to 85% less corrosion, based on the deepest pitting in the pipe carrying untreated water. The best results were found with a steel pipe.

Mr. Speller's paper was accompanied by a number of lantern slides, including several arrangements of test apparatus, the general results showing marked reduction in the pitting when using deoxidized water.

Mr. Blackmore asked if the filter used with the deoxidizing apparatus was capable of removing all the rust accumulating in the deoxidizer.

Mr. Carrier said that in air conditioning work the presence of sulphuric acid in soft coal smoke was something that causes considerable trouble in corroding the pipes.

Mr. Wilcox said in some cases a float valve has been used which will open to allow the gases to escape from a hot water tank, but will close against the water. This, he said, had been effective in preventing rust.

An extra paper was then presented by Professor John R. Allen on "Comparison of Pipe Coil and Cast-Iron Sections for Warming Air." This paper was also illustrated by lantern slides. It was really a comparison of tests made on pipe coils and on Vento cast-iron heaters, made at the American Radiator Company's Institute of Thermal Research. Prof. Allen showed that under similar conditions the condensation in each type of heater is practically the same.

The principal conclusion reached by Prof. Allen was that the condensation depends almost entirely on the frictional resistance and not on the free area of the coils. In fact, Prof. Allen went so far as to say that, in his own opinion, it makes very little difference what materials are used in the coils or heaters, as far as the condensation is concerned.

One chart, drawn on logarithmic paper, was especially interesting as showing an exhaustive comparison, for a number of sections, of operating data for coil heaters and Vento heaters.

Morning Session, Jan. 17.

The Wednesday afternoon session proved to be largely a central heating session. The first paper was presented by J. H. Walker on "The Transmission of Steam in a Central Heating Sytem."

(This paper will be published in next month's issue.)

Replying to a question as to the scouring effect of the superheated steam in the "feeder" lines, Mr. Walker stated that no scouring effect had been noted, as thermometer wells located for over a year in the lines, still showed the manufacturers' marks. He thought this was due to the dry steam and the straight runs. When there were turns, easy bends were used.

George H. Nichols, head of the engineering department of the New York State Architect's office, then presented a paper on "Efficiency of Underground Conduit."

Efficiency of Underground Conduit.

In this paper Mr. Nichols presented a definition and a standard method of arriving at the thermal efficiency of the various classes of material used for covering underground heating mains. He could see no reason why the heat loss from bare pipe should not be adopted as a standard efficiency basis. Mr. Nichols distinguished between the various types of construction by dividing them into classes: mains installed in a concrete or brick walking tunnel, and mains installed in some form of waterproof envelope.

After taking up the points to be considered in deciding on the type of insulation the author then presented the results of two tests which, he stated, were not given as a comparison of the materials of the two installations, but to show the average efficiencies that can be expected and the methods that can be followed in testing such installations. The efficiency of the insulating material as installed is, for one test (Central Islip) 91.9% and for the other test (Ward's Island), 83.9%.

Mr. Walker said that in taking bare pipe as a basis for figuring efficiency, it would be necessary to have the bare pipe tested underground. As for ventilating pipe tunnels, Mr. Walker said it would be necessary to have such ventilation, as otherwise the men could not work in them, owing to the heat.

Professor Allen said that if the bare pipe were buried deep enough there would be no need of any insulation.

Professor L. B. McMillan showed a chart giving a comparison of results on heat losses from different sizes of bare pipe. The tests included those made by the Massachusetts College of Technology, George H. Barrus, George M. Brill, Charles Eberle, C. L. Norton, Box, and the speaker at the University of Wisconsin.

Mr. Wells stated that in tests made by the American District Steam Company it was found necessary to have the pipes of the same diameter. It was also important, he said, that the tests be made under the same conditions and for the same length of time.

In the tests referred to, his company had four lines in operation at once. At first, saturated steam was used, but later it was found advisable to use superheated steam at 1° or 2° superheat. He stated that the efficiency of a pipe tunnel depends on the insulation used rather on the conduit itself. The loss by convection is the important factor.

Prof. Allen expressed surprise at Mr. Nichols's figure of $20.00 per running foot for pipe tunnel construction. He said his cost for this class of work was usually about $10.00 per running foot.

Mr. McColl said his experience justified the figure of $1.00 per running foot for each diameter of pipe used.

Mr. Walker said this might hold true for 6-in. or 8-in. pipe, but not for pipes of lower diameter, in which cases the cost would be higher proportionately. He also said that with the rising cost of labor it would be unsafe to use these figures in the future, but that allowance would have to be made for greater labor costs.

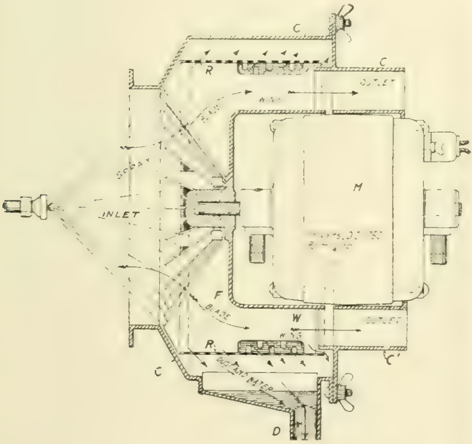
In closing Mr. Nichols said that if comparisons were to be made of bare pipe when actually installed underground, it would be necessary to specify the nature of the soil, etc. He therefore thought that the bare pipe basis, as he proposed, would be as satisfactory as any other. The tests, he said, although of short duration, were made at the ends of long runs. Replying to a question regarding the economy of central heating plants, he said there was undoubtedly an economy in institutional work where the buildings were of considerable dimensions.

Dr. E. Vernon Hill of the Chicago Division of Ventilation then read a paper on "Windows."

The last speaker at the afternoon session was William J. Baldwin, who read a paper on "An Improvement in Ventilating Apparatus," describing a unique type of fan designed by him and first demonstrated at the last midsummer meeting of the heating engineers' society in Detroit.

An Improvement in Ventilating Apparatus.

In this paper Mr. Baldwin described what he called an "aero-hydro fan-separator" a model of which he had on exhibition at last summer's meeting of the heating engineers in Detroit. The apparatus shown in the paper was designed for a hospital ship but it may be adapted for use, he said, in any place where it is desired to take in air in ample quantities, and exclude rain, or spray or dust. Photographs were included showing various features of the construction of this apparatus, but its principle of operation may be gathered from the accompanying illustration. In addition to its use on a steam ship, the apparatus may be used to take dust or cinders from the air of a chimney, to take care of soft coal smoke and for several industrial processes, including copper refining, the removal of tin, lead, zinc, etc., from hot gases, for car ventilation and as either a humidifier or drier. An important feature of the apparatus is that it is self-cleaning, whether wet or dry.



LONGITUDINAL SECTION THROUGH THE AERO-HYDRO FAN SEPARATOR.

Before Mr. Baldwin demonstrated his machine, a topic for discussion was taken up on "Heat Transmission Through Various Types of Sash." This took the form of a discussion of Arthur N. Sheldon's paper on "Heat Transmission Through Various Types of Sash," presented at the recent annual meeting of The American Society of Mechanical Engineers and published in THE HEATING AND VENTILATING MAGAZINE for December, 1916.

The paper was read in abstract by Secretary Obert.

Mr. Baldwin in discussing this topic quoted the practice of Gen. Meigs, at one time Quartermaster-General of the U. S. Army, who allowed one-third less for double-glazing than for single glazing and for triple-glazing one-third less was again allowed between the second and third sash.

Mr. Davis said that with metal sash it is difficult to get a putty or other material that will stick to both the glass and the metal. He said it might be possible to have this tight in laboratory tests, but that the author of the tests quoted would find it impossible to maintain this tightness in ordinary practice.

M. S. Cooley said the fact that dust will sometimes accumulate on a double-sash window shows that there is a very considerable leakage through both sashes.

It was announced that as Dr. E. Vernon Hill had an interesting chart to present on air, a special topic would be introduced for his benefit on "Interior Air Conditions."

This chart was intended to aid ventilation inspection departments in making tests and remedying unsatisfactory air conditions.

Morning Session, January 18.

A symposium on drying was the feature of the Thursday morning session. Three papers on this subject were presented, one on "Artificial Drying, with Special Reference to the Use of Gas," by Gilbert C. Shadwell, of the Improved Appliance Co., Brooklyn, N. Y.; one on "Drying by Evaporation," by F. R. Still;

and a third on "Drying in Industrial Plants," by J. O. Ross, of the B. F. Sturtevant Co.

Artificial Drying, with Special Reference to the Use of Gas.

Mr. Shadwell's paper was a strong indorsement of the use of gas in drying processes. He described in particular a type of heater or hot air generator, manufactured for drying work by the Improved Appliance Co., of Brooklyn, N. Y. Several examples were given of the use of this apparatus for various drying processes, as well as the calculations used in sizing the installations.

Mr. Shadwell presented the advantages in the use of gas for drying that developed into a lively discussion on the part of the gas and solid fuel drying advocates. Among the advantages of gas presented by Mr. Shadwell were the fact that no storage capacity is required, easy heat control is possible, it is capable of taking care of large as well as small installations, while it is so safe that watches are being dried by gas heat, as well as photographic films. In drying fish it was pointed out the use of the drying process on damp days had effected an enormous saving. Mr. Shadwell put in a plea that the heating engineers take a wide interest in the use of gas heat, not only in industrial processes but in auxiliary house heating.

Dr. Franklin thought the society should procure comparative prices of coal, gas and electric current throughout the country. He said that radical changes were coming in the art of gas burning, and that the rising prices of coal were coming to have an important bearing on the matter.

Mr. McIntyre said it was important to have the air inlets and outlets properly placed, as during the process it is often necessary to change these locations during a given operation.

Another point brought out was that although on paper the difference in the heat content of coal and gas greatly favored the use of coal, the efficiencies possible in the application of gas made this difference disappear. A case was cited in the melting of asphalt in which gas was beating out the solid fuels. When the handling of coal and the speed of drying is taken into consideration, there are very few operations that cannot make use of gas to advantage.

Mr. Carrier said that while gas may be used to better advantage in small plants, operating intermittently, he felt that the gas interests were hurting their case in urging gas as a substitute for steam in large installations. He said that it must be remembered that gas at 80c per 1,000 cu. ft. compared with soft coal at $5.00 per ton gives 900,000 B.T.U. for $1.00 for gas as against 5,000,000 B.T.U. for the same cost in coal, or a ratio of about 1 to 5½. He appreciated the efficiency of application with gas, but considered that there was a limit to this advantage.

In closing Mr. Shadwell compared the proposition to the use of an automobile and buggy. An automobile may cost more, but it is acknowledged to be better and is supplanting the buggy. He said the comparative heat values of the fuel are not the determining factors, but the final cost of the product.

The discussion of Mr. Still's paper was deferred until Mr. Ross's paper had been presented.

Drying in Industrial Plants.

Mr. Ross describes the principal drying processes now in use, commencing with the filter press, or squeeze rolls generally used in the clay and chemical industries. The settling tank was then described, in general use in the starch industry in Europe. Evaporating kettles were next taken up.

One of the first decisions to be made, he said, is whether the dryer should handle the material continuously or in batches. A progressive dryer in which the material moves gradually or continuously, either on trucks or conveyors, offers many advantages in cost of labor and economy of heat. The drawbacks of this process were given by Mr. Ross as:

1. When the material comes from the machine in batches;
2. When the variety of the material differs widely in drying requirements;

3. When the material requires different treatment than a gradual increase in temperature and decrease in humidity of the air.

He also said that material which dries fast is more adaptable to a progressive dryer than material which dries slowly.

Mr. Ross gave a description of the so-called bed or screen type of dryer, consisting of a horizontal screen on which the loose material to be dried, is thrown. Still another type described was the cylindrical type, consisting of a round cylinder usually on an incline.

A discussion of these papers brought out the part being played by the commercial engineer, one speaker stating that one of the troubles in connection with the use of drying apparatus was due to the desire of the salesman to make as large a sale as possible.

Mr. Davis said that 70% of the advance in this field was due to the commercial engineer, and that so long as the owners failed to appreciate that the salesmen's time was as valuable as the consulting engineer's, there would probably be the practice of providing for this item in the extra apparatus sold. He said that the commercial engineer's time should be paid for, whether or not he secured the order.

Mr. Carrier said it should be borne in mind that every finished product has a normal amount of moisture, ranging from 5% to 15%, so that the drying process never means the entire drying of the product.

In concluding the discussion Mr. Still said it was the province of the society to determine what is 100% in drying. It would then be up to the specialist to determine his own factor of safety. He suggested that committees be appointed to formulate such standards.

President Hart announced the death of Alfred E. Kenrick, a former president of the heating engineer's society, who died January 16, at his home in Brookline, Mass. On motion made by Mr. Chew it was voted to have the council formulate a suitable resolution and appoint a committee to attend the funeral.

Before the session adjourned, a resolution was read providing for the appointment of a committee to co-operate with the National Association of School Accounting officers, the American Institute of Architects and the National Education Association in formulating standard school building measurements, so that any discussion of such measurements would be on the same basis.

This matter was brought to the attention of the society by Edwin C. Baldwin, of the Massachusetts Board of Education.

Afternoon Session, January 18.

The final session was opened with the presentation of a paper on "Heating, Ventilating and Electrical Equipments of the Philadelphia Public School Buildings, High and Elementary," by J. D. Cassell, chief of the engineering department of the Philadelphia Board of Education.

Frank G. McCann thought that a pressure on cast-iron radiators of 30 lbs. per square inch was too high. In answer to this and other questions Mr. Cassell stated that he had used a 30-lb. steam pressure for 25 years, and had never experienced any trouble. There was at times some hissing noise in the radiators, but this, he said, was not due to the pressure, but to the action of the thermostats.

Regard the amount of coal burned per year, Mr. Cassell said that in one building containing 360,000 cu. ft. of space, the consumption for one year was 150 tons of pea coal, or 1.2 lbs. per cu. ft. per year. This building, however, contains from 18% to 20% of glass surface while the newer buildings have from 25% to 30%. Mr. Cassell also spoke of a difference of 50 tons in the fuel consumption in one year for two buildings of similar construction, showing that such figures should be accepted with some caution.

A paper on "Heating and Ventilating a Portable School House," was presented by J. R. McColl.

Mr. Cassell, in discussing this paper, paid a high tribute to the author's design for this type of apparatus. No uniformity of results, he said, can ordinarily be obtained with gravity furnace heating, but with a fan the desired uniformity can be obtained. No humidity devices were used, said Mr. McColl, in answer to a question, as the buildings were located some distance from the main school building and it was not found convenient to run a water line to the portable buildings. At first the motors, which were of ½ h.p. were noisy, but this was remedied by placing them on concrete or brick foundations. The fan is run continuously when the school is in session.

The concluding paper was on "Remodeling the Ventilation of a Theatre," by Samuel R. Lewis.

MOVEMENT TO ESTABLISH RESEARCH LABORATORY.

An item of business came up at this point in connection with a proposition to establish a fellowship at the University of Michigan. Mr. Lyle favored the proposition of establishing a chair of engineering research by the society. It was estimated that the total cost of a fellowship would be about $1,600 a year. Mr. Hart thought that if the society should undertake to establish a bureau of research, it could probably enlist government aid to cover a portion of the expense.

On motion of Mr. Boyden it was voted to appoint a committee to consider the establishment of a research laboratory. Mr. Still said that the U. S. Bureau of Standards had stated that the engineering public does not appreciate the opportunities it offers for making desired tests and investigations and he thought the society could get many tests made by the Bureau of Standards if it went about it the right way.

INSTALLATION OF OFFICERS.

President Hart, after thanking the officers and members for their support, appointed Frank K. Chew and James H. Davis a committee to escort the newly-elected officers and members of the council to the platform. They were then installed with due ceremony, President Lyle responding to the retiring president's welcome by pledging his efforts to promote the society's interests during the coming year.

Suitable responses were made by the other officers, including Secretary C. W. Obert, who was given liberal credit for his conscientious and effective work during the past year.

The meeting then adjourned.

The Entertainment.

Between luncheons, matinées and dinner parties the ladies were given a full round of entertainment throughout the meeting. On the opening day, Tuesday, they were taken to the Strand Theatre, where the moving pictures were supplemented by a musical programme. That evening the ladies, in charge of W. H. Driscoll, H. G. Issertell and W. G. Le Compte, were taken to Churchill's for dinner, staying for the cabaret.

Wednesday afternoon the committee selected "Old Lady 31" at the Thirty-Ninth Street Theatre as the play for the matinée Party. This proved a delightful comedy, with an undercurrent of pathos that has made the play widely known among theatre-goers. Messrs. Issertell and J. Barton Garfield accompanied the party.

The annual dinner of the society was scheduled for the same evening at the Hotel Astor. This proved a most delightful event. The beautiful Rose Room on the Forty-Fourth Street side had been secured for the occasion and, both in its appointments and setting, the dinner was pronounced one of the most attractive the society has ever held. R. W. Pryor, Jr., who had direct charge of the dinner arrangements, came in for high praise for the success of his plans.

It was not intended that there should be a lengthy programme of speeches, so those scheduled to speak included only the retiring president, H. M. Hart; the new president, J. Irvine Lyle; and Charles N. Green, attorney for the American Brass Company.

Mr. Hart, who acted as toastmaster, made a witty speech, appropriating due credit for the prosperity of the society as well as of the country in general. Before he concluded, however, he took the opportunity to thank his associates for their splendid work during the past year.

President-elect J. Irvine Lyle was then introduced and was warmly greeted. Mr. Lyle gave a thoughtful address on the efforts of the Government to promote agriculture and the need of securing the same sort of government assistance for engineering. The United States Government, he said, has spent millions of dollars in agricultural extension work, through the establishment of experiment stations. The results of its investigations are placed before the farmer in such a way that he can make use of them. The whole movement is to further farm economics. But what about the skilled mechanic, asked the speaker. There are no experimental stations for his benefit, with the exception of the Bureau of Standards. A bill is now before Congress, he said, to establish experiment stations at the different universities for the benefit of the engineer. This, he said, was a move in the right direction and he urged a wider interest in this matter on the part of the engineering profession.

Mr. Lyle's address was well received, the applause indicating enthusiastic approval of the suggestions presented.

After a period of dancing between the courses, the final speaker Charles N. Green, was introduced. Mr. Green spoke on "Efficiency in Manufacturing Work." His references were chiefly to the correct selection of men for particular positions. He pointed out the characteristics of the methodical man and compared them with those of the man "out of a rut." He said the time has come when haphazard methods of selected men must be abandoned and men selected for particular positions only after their characteristics had been studied.

A novelty was introduced at the close of the dinner in the form of a glee club concert by 35 members of the Friendly Sons of St. Patrick. This club was rehearsing in another part of the hotel and were introduced through the courtesy of William H. McKiever, of New York.

Three songs were rendered by the glee club, including an old Irish battle song and a very old lullaby. All three songs were finely rendered and won hearty outbursts of applause.

This concluded the dinner programme and the room was then given up to dancing to the music of Muller's orchestra.

Friday morning the ladies met at headquarters and were taken in Black and White taxis to Wanamaker's by Messrs. Kiewitz, LeCompte, Dornheim and Garfield. Here they were shown through the store by guides, visiting the antique shops, the "Palace Palatial," the hospital and store school. Luncheon was served in the tea room at one large table and the party then proceeded to the auditorium where the programme included several organ compositions and a number of songs by three soloists

The following members of the Entertainment Committee were on duty in the lobby or took an active part in carrying out the programme: A. S. Armagnac, chairman; R. W. Pryor, Jr. (dinner), B. K. Strader (dinner), W. H. Driscoll (ladies), P. H. Seward (finance), George D. Farnham (programme), G. A. Dornheim (programme), M. W. Franklin (speakers), W. H. McKiever, Walter S. Timmis, A. E. Carpenter, Jr.; W. G. LeCompte, H. G. Issertell. J. Barton Garfield also served actively with the committee.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

New Chapter Formed in Kansas City.

On the application of twenty-seven members of The American Society of Heating and Ventilating Engineers in and near Kansas City, Mo., a charter has been granted for a local chapter of the society at that point. Pending action by the society the chapter elected the following officers at a meeting in Kansas City in January:

President, Prof. J. M. Kent; vice-president, B. Natkin; secretary, F. A. DeBoos; treasurer, E. A. Cline. Members of council; John H. Kitchen, Herbert H. Whitten and Walter Gillham.

The following have joined the chapter or have signed applications for membership:

Herbert H. Whitten, James M. Kent, John H. Kitchen, R. F. Taylor, Ben. Natkin, Wm. Mallis, F. A. DeBoos, E. A. Cline, Prof. J. D. Hoffman, B. R. Hull, Leslie Byson, B. A. Broom, Walter E. Gillham, E. C. Waddington, M. N. McIntyre, R. L. Dunlap, F. A. Griffin, Martin Hauser, L. A. Stephenson, John G. Pease, F. J. McMorran, W. W. Howe, F. Chockley, W. B. Irwin, H. H. Wright, A. R. Hardy and H. N. Booth.

Illinois Chapter Hears Address on Smoke Abatement.

An address by J. W. Henderson, chief of the bureau of smoke regulation of Pittsburgh, Pa., was the principal feature of the January meeting of the Illinois Chapter, which was held at the Engineers' Club, Chicago, January 8. Mr. Henderson told the fifty members and guests who attended the meeting about the progress that has been made in smoke abatement in Pittsburgh, Pa. In lantern slides which accompanied his address some remarkable comparisons were shown between conditions before and after the smoke abatement campaign was undertaken.

Mr. Henderson prefaced his remarks by stating that smoke abatement is fundamentally a heating and ventilating problem. He cited a case in point where a heating boiler for a garage was placed in a cement basement room which was practically air-tight when the door was closed. No provision was made for letting the air into the room, as the walls were all solid.

The single-grate boiler, he said, cannot be operated without smoke within even the limitations of the liberal smoke ordinance of today, using Pittsburgh vein bituminous and similar long-flame coals.

The experience of Pittsburgh has proven that it is always best to use mechanical stokers. The next best alternative is semi-mechanical stoking, when the requirements are such as to call for tubular boilers.

Mr. Henderson stated that the production of smoke in Pittsburgh has been reduced more than one-half during the two years and ten months that smoke abatement has been systematically pushed. Moreover this result has been accomplished with no prosecutions thus far under the present administration. There are, however, a few concerns, said Mr. Henderson, that seemed destined to impel the city to take such steps to secure obedience to the law. The shortage of natural gas during the winter months and sudden reverting to the use of soft coal brings many new cases to the front all the time, so that smoke abatement in that city is not fully accomplished, by any means.

In concluding he stated: "There is not a boiler, furnace or metallurgical furnace stack that cannot be made to comply with the smoke ordinances of most cities." The Pittsburgh ordinance prescribes that the production and emission of dense smoke for an aggregate of one minute in any period of eight minutes, for locomotives and steamboats; and two minutes in any period of 15 min., for stationary stacks, constitute a violation punishable by fine or imprisonment or both.

Mr. Henderson was given a rising vote of thanks. The usual chapter dinner preceded the address.

Address on "Proportioning Radiation" Before the Michigan Chapter.

Ralph Collamore of Detroit was the principal speaker at the January meeting of the Michigan Chapter which was held January 5 and took the form of a joint meeting with the Detroit Engineering Society. Mr. Collamore's subject was "A Method of Proportioning Direct and Indirect Radiation." The address was followed by a lively discussion in which the members of both organizations took part.

The chapter adopted a resolution recommending a uniform method of testing boilers.

Four applications for membership were received and accepted, making the total membership of the chapter 77.

NATIONAL DISTRICT HEATING ASSOCIATION

Programme for Ninth Annual Convention.

An elaborate programme of papers and committee reports has been prepared for the ninth annual convention of the National District Heating Association, which will be held in Detroit, June 12-15, 1917. Prof. J. D. Hoffman, of the University of Nebraska, will present a paper on "A Study of District Heating in the Central West." Nelson S. Thompson, of the Supervising Architect's Office, in Washington, will have a paper on the "Central Heating and Lighting System of the Government's Buildings." Other papers will be: "Rates and Rate Making," by Halford Erickson, formerly chairman of the Railroad Commission of Wisconsin; "Heat Losses from Mains under Various Conditions," by R. C. March, of Chicago; "Ash- and Coal-Handling Problems," by J. L. Hecht of Chicago and G. W. Martin, of New York; "Special Furnace Design and Boiler Insulation" and "Use and Results from Indicating and Testing Instruments in the Boiler Room," by Joseph Harrington, of Chicago.

Prof. John R. Allen, of the University of Michigan, will deliver an address on experiments with heating and other apparatus which he has been conducting at that university.

Sub-committee reports will include one on "The Use of the Bonus System in the Boiler Room," by Messrs. De Wolf, Harrington and Hobbs; another on "Feed Water Treatment," by Messrs. Vater, De Wolf and Shaw; and a third on "Recent Station Progress."

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Fred R. Still, chief engineer of the American Blower Co., Detroit, Mich., has sailed for Belfast, Ireland, where the plant of Davidson & Co., the original manufacturer of Sirocco fans, is located. Mr. Still will inspect some new fan designs which have been developed at this plant.

LEGAL DECISIONS

Radiator Patents.

In a suit for infringement of patent for a radiator, the Circuit Court of Appeals, Second Circuit, in reversing a decree of the District Court, S. D., New York, the Court said:

"We have held that claims 1 and 2 of the Fowler & Wolfe patent, No. 609,800, for radiators read in connection with the specification, while of narrow scope, are valid. Fowler & Wolfe v. McCrum-Howell Co., 215 Fed., 905, 132 C. C. A., 143, to which reference may be made for a fuller statement of the facts. The radiator of that patent is a cast-iron section or unit containing four outside large hollow tubes and two or more similar cross tubes, the latter being connected by smaller connecting tubes. It is primarily a wall radiator and being the first of such in the art was a great success. These sections may be united to make radiators of any size desired. A particular advantage mentioned in the specifications is that increased radiating surface may be had without taking up floor space. The feature we held to be patentable was that the cross tubes, being larger and longer than the connecting tubes, a better circulation of hot air or water whichever was used, was secured. Of course the heating principle is the same in a floor as in a wall radiator. Several earlier patents for floor radiators, notably Wood, No. 176,915, and Safford, No. 355,216, were relied upon by the defendant in the former case. We held them to be no defense, because they did not show the relative difference in size between the cross and the connecting tubes above pointed out.

"In this case, however, there are produced two floor radiators manufactured some years before the Fowler & Wolfe patent was applied for, the Jarecki and the International, which are made up of unitary sections of four large outside tubes, two large cross tubes with two smaller connecting tubes. This is the construction of the Fowler & Wolfe patent. The fact that there are fewer connecting tubes than those appearing in the drawings of that patent and that they are shorter is immaterial, because it calls for a series without prescribing any particular number or any particular length of the connecting tubes. Moreover, it makes no difference whether the cross tubes are of a perpendicular or horizontal position. We think that a radiator made after the Fowler & Wolfe patent, though with but from two to five connecting tubes and shorter than the series of six appearing in the drawings of the patent, would unquestionably infringe, and conversely, if in use before the patent was applied for, would anticipate it. The principle of construction and the function is the same, and accomplished in the same way; the difference being only one of degree.

"In view of the prior uses now established, the decree of the District Court is reversed." Fowler & Wolfe Mfg. Co., vs. Richmond Radiator Co., 234 Fed., 635.

Acceptance of Bid for Installation.

An action was brought to recover profits which plaintiff would have made in the performance of a certain contract with the defendant, had it been allowed to enter into and perform that contract. The plaintiff recovered a judgment, based upon the verdict of a jury, for $1,162.26.

The plaintiff is engaged in the business of installing heating and ventilating plants in public schools and buildings. The defendant is a corporation having charge of the educational interests of Manhasset in the town of North Hempstead, Long Island. The plaintiff, pursuant to an advertisement for the construction of a new school building by the defendant at Manhasset, submitted a bid for the construction of the heating and ventilating plant. The advertisement stated that information concerning the work to be done could be secured from Frederick H. Briggs, an architect, at Plandome, L. I. The plaintiff, through its then secretary, communicated with Mr. Briggs, and in answer to that communication received a letter from Briggs, stating where plaintiff could get a set of blue-prints and specifications for the construction of the new school. This letter also stated that sealed proposals would be received by the clerk of the board of education until January 8, 1915, up to 7:30 p. m., for the general construction of the new high school.

On January 8, 1915, the plaintiff's representative, Mr. Textorious, appeared before the board of education and submitted plaintiff's bid, together with a certified check for 5 per cent of the amount of its bid, and a surety company bond. The bid of the plaintiff proposed to furnish all the material, labor, and install complete the heating and ventilating plant in accordance with the plans and specifications for $5,216. Thereupon the board proceeded to open and announce the names of the bidders, and the amounts of the bids were placed on a blackboard under separate heads, and remained there throughout the evening. On the blackboard the plaintiff's bid of $5,216 appeared as the lowest bid for the ventilating and heating. After opening the bids and putting them on the blackboard the board went into an executive meeting in an adjoining room. While they were in session a member of the board named Bellows came out of the meeting and told Textorious that the contract had been awarded to the plaintiff. Bellows also said it would not be necessary for Textorious to remain there, that they would not enter into any contract before they had sold their bonds, and that the contract was plaintiff's when they had sold the bonds.

It appeared from the minutes of this meeting, which were put in evidence by the plaintiff, that the bid of the plaintiff was accepted in the following words:

> "Under date of the special meeting of the board of education on Friday, January 8, 1915: Regularly moved, seconded, and carried that the Johnston Heating Company's estimate for the heating be accepted, provided the bonds are sold—estimate, $5,216."

The board then adjourned to hold a special meeting on January 8, 1915, when the minutes of January 8th were approved. On the following day the witness Textorious, representing plaintiff, had a conversation over the telephone with Mr. Bellows, in which conversation Bellows stated again that the contract had been awarded to the plaintiff. Thereafter, and on or about January 13th, the plaintiff received a letter from the clerk of the defendant, returning his check and bond, and telling plaintiff that Hynes Bros., of Great Neck Station, had been awarded the contract for heating and plumbing. It appears from the minutes of January 9, 1915, that the resolution to accept the estimate of the Johnston Heating Company was rescinded and the certified check directed to be returned. At the same meeting a resolution was adopted accepting the estimate of Hynes Bros., not only for the plumbing, but for heating, in one bid aggregating $10,285. When the plaintiff received the notification that the contract for heating and plumbing had been taken away from it and awarded to Hynes Bros., of Great Neck, it notified the defendant of its willingness to enter into a contract and comply with all its terms and conditions. The defendant rerefused to allow the plaintiff to perform, and did not readvertise for bids, but went ahead and advertised for the sale of the bonds, and the bonds were finally sold.

The plaintiff claims that its bid was fully accepted, and the acceptance communicated to the plaintiff, in a way to bind the defendant, and that that acceptance constituted a contract between the parties, although no formal contract had as yet been executed. The defendant, on the other hand, claims that there was no acceptance, and consequently there was no contract, and that the court should have dismissed the complaint.

On appeal from the judgment the Court said:

"It is apparent from this testimony that the plaintiff was the lowest bidder, and that his bid had been accepted by resolution of the board; but there is no evidence that the acceptance was ever communicated to the plaintiff by any person acting under authority of the board. It may all be true that Mr. Bellows told plaintiff's agent that the bid was accepted (although Bellows denies this); nevertheless it is not shown by any evidence whatever that Bellows had any authority to make this communication on behalf of the board. In the absence of an authorized notice of acceptance of plaintiff's bid, the board had a perfect right to rescind its resolution accepting plaintiff's bid. The question of the legality of the board's action in accepting some other bid in place of plaintiff's is not now before this court. We simply decide that the board's action in revoking its acceptance of plaintiff's bid was quite within its legal right."

It was held that there was no evidence to go before the jury and that the action should have been dismissed. Johnston Heating Co., vs. Board of Education, New York Appellate Division, 161 N. Y. Supp., 867.

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Current Heating and Ventilating Literature.

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

HEAT LOSS

Heat Loss Through Buildings and Building Material. R. S. Hawley. 500 w. Col Sl Min Qt—July, 1916. Self-explanatory chart with notes.

PIPE COVERINGS

The Effect of Surface Conditions Upon the Rate of Heat Transmission Through Steam Pipe Coverings. A. D. Fulton and R. C. Parlett. 2500 w. Wis Engr.—Nov., 1916. Serial, 1st part. Thesis for degree of Mech. Engr. Research work.

Fresh Air for Submarines.

A recent announcement stated that a new process for supplying pure air to submarines have been invented by William G. Bond, of Wilmington, Del. The air, it was stated, is purified by a chemical reaction between carbon dioxide and certain solutions exposed to the atmosphere of the chamber, the carbon being absorbed and the oxygen liberated. A test chamber was made 3 ft. x 4 ft. x 6 ft. and in a demonstration of the apparatus the inventor remained in the test chamber for 7 hours with only the air furnished by his device.

The test room used was entirely surrounded by water. Mr. Bond entered the tank clad in a bathing suit and supplied with reading matter, food, air testing apparatus and the chemicals. He kept in communication with the observers on the outside by means of a telephone. At a stated time the supply of oxygen furnished by the apparatus was cut off and he remained for three-quarters of an hour longer in the chamber. Although the air had been perfectly wholesome for seven hours, at the end of the additional 45 min. the inventor emerged breathing very heavily.

In writing of his invention, which is described as the Scott-Bond process for purifying air, Mr. Bond, states:

"This process relates to a process whereby carbon dioxide may be removed from air and the oxygen equivalent thereof may be continuously and automatically returned to the air. The process is founded on perfect theoretical chemical principles and with one passing of the air fulfills both the regenerating and purifying functions; that is, the supplying of oxygen, absorption of carbon dioxide, and the purifying of the air of its other toxic constituents.

"The machine itself consists of a nest of shelves submerged in a container, the air being brought into contact with the liquid by means of a blower fan or any other means of propelling same.

"The process is purely a chemical one and is operative by and therefore proportional to the carbon dioxide, and does not depend on the humidity, as the oxylithe process does. We have never found any fixed relation of humidity and carbon dioxide in exhaled air.

"The curves from our experiments shows our process to be very flexible. The oxygen and carbon dioxide lines follow each other as they theoretically should, varying with such changes as would naturally affect them; namely, changes in volume of carbon dioxide, volume of air passing through machine, and area of exposed chemicals.

"The process is capable of being manufactured so that one charge would last about twelve hours and by having an extra set of trays the new charge could be inserted in less than five minutes. The volume of air passing through the machine could be constant and no regulations would be needed for any change in rate of vitiating air. If the air should be vitiated before starting the machine, the machine would purify the air after being started."

Shall Clocks Be Set Ahead One Hour?

One of the important items on the programme of the fifth annual meeting of the Chamber of Commerce of the United States, held in Washington recently, was the subject of daylight. Robert Garland, chairman of a committee which has been studying the question, made definite recommendations for the setting ahead of clocks one hour. It was pointed out that Germany, France, England and Italy and other countries have adopted this system, while Cleveland and Detroit, in 1914, set their clocks an hour forward. Reports from officials and commercial organizations in these cities stated that the change was made without difficulty and has met with practically universal favor.

◆

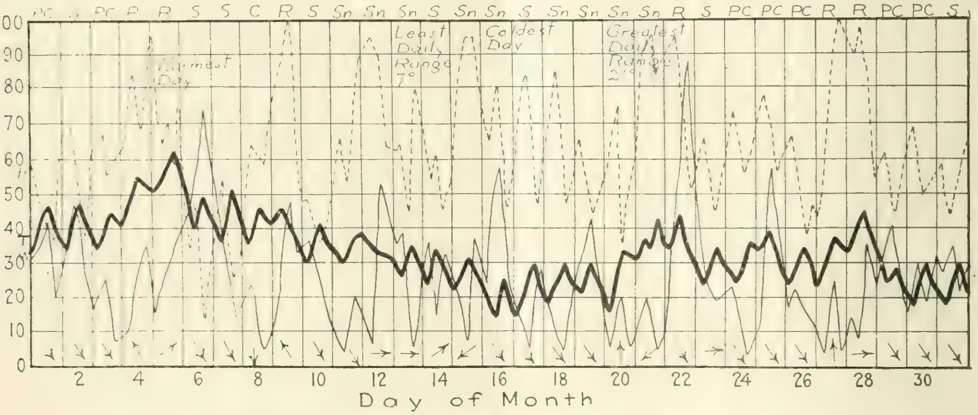
A course in ventilation and ventilation measurements is announced by the College of the City of New York. The course is conducted by George S. Palmer, M.S., chief of investigating staff, New York State Commission on Ventilation. Sessions are held on Thursday evenings, beginning February 8, from 8:25 to 10:13 o'clock. The course is offered to meet the needs of those whose daily work brings before them problems of ventilation, teachers, nurses, medical inspectors, assistants in the offices of heating and ventilating engineers, contractors and manufacturing concerns. The fee for the complete course is $5.00.

◆

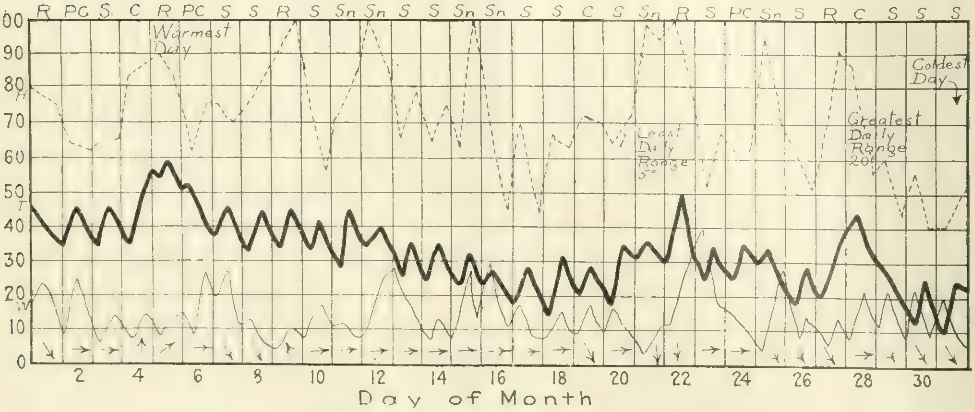
Central Supply Association will hold its winter meeting in Chicago, at the Congress Hotel, February 28.

The Weather for December, 1916.

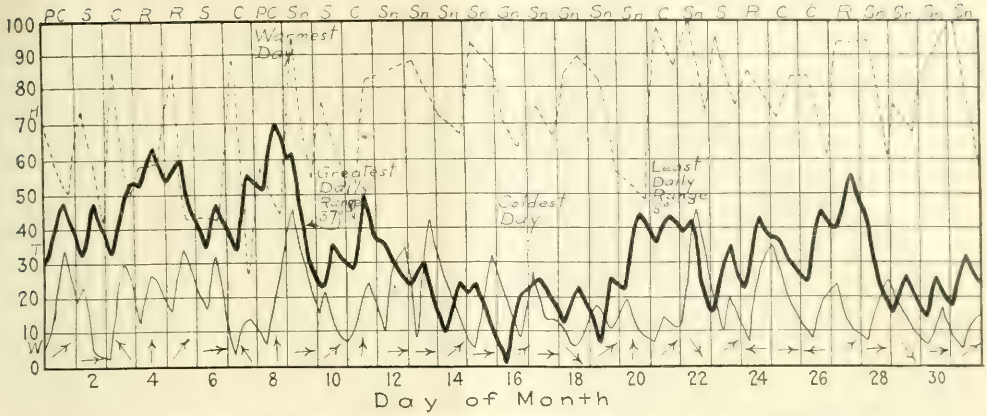
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	62	59	70	64	71
Date of highest temperature	5	5	8	7	4
Lowest temperature, degrees F.	15	10	1	—2	2
Date of lowest temperature	16	31	16	22	15
Greatest daily range, degrees F.	21	20	37	33	36
Date of greatest daily range	20	27	9	8	16
Least daily range, degrees F.	7	5	6	6	4
Date of least daily range	13	21	21	9	21
Mean temperature for month, degrees F.	33.8	33	33	26	33.6
Normal mean temp. for month, deg. F.	34.4	31.6	34.7	29.3	35.5
Total rainfall, in.	3.97	3.0	2.01	2.58	2.16
Total snowfall, in.	13.7	9.5	5.8	7.1	2.5
Normal precipitation, this month, in.	3.45	3.41	2.73	2.07	2.23
Total wind movement, miles	15335	9447	9385	9778	10815
Prevailing direction of wind	N.W.	W.	W.	N.W.	S.
Average hourly wind velocity, miles	20.6	12.7	12.6	13.1	14.5
Number of clear days	9	14	6	15	12
Number of partly cloudy days	12	7	6	5	7
Number of cloudy days	10	10	19	11	12
Number of days on which rain fell	16	12	13	16	8
Number of days on which snow fell	10	6	15	13	6
Snow on ground at end of month, in.	None	Trace	Trace	0.4	None



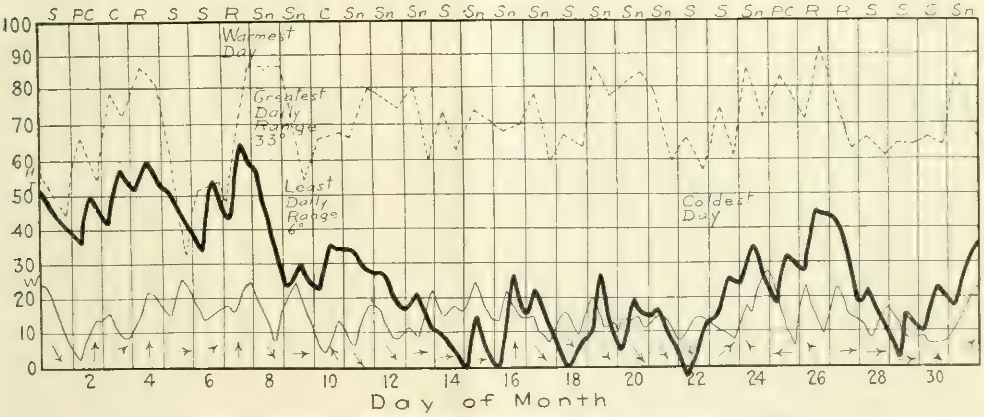
RECORD OF THE WEATHER IN NEW YORK FOR DECEMBER, 1916.
(Hourly Observations of the Humidity Are Recorded on This Chart.)



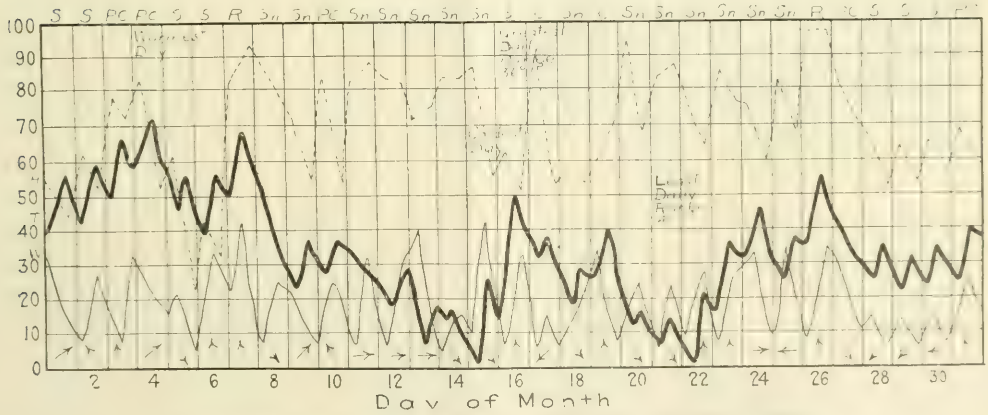
RECORD OF THE WEATHER IN BOSTON FOR DECEMBER, 1916.



RECORD OF THE WEATHER IN PITTSBURGH FOR DECEMBER, 1916.



RECORD OF THE WEATHER IN CHICAGO FOR DECEMBER, 1916.



RECORD OF THE WEATHER IN ST. LOUIS FOR DECEMBER, 1916.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

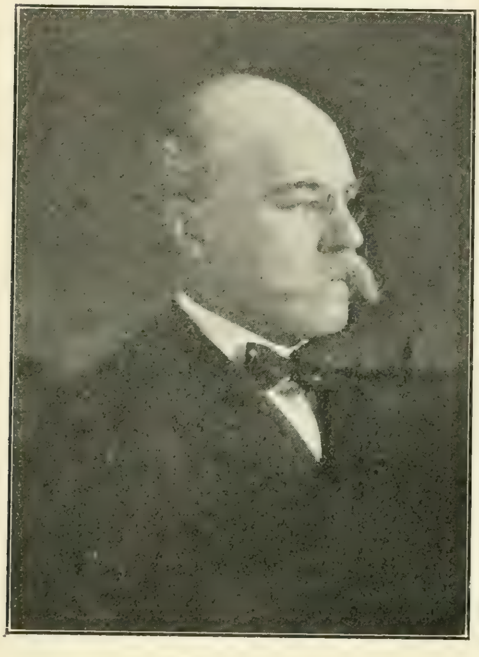
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

Death of Alfred B. Jenkins.

A notable figure in the heating trade and a man who had a prominent part in the development of the steam fitting industry in this country passed away when Alfred B. Jenkins, president of Jenkins Bros., New York, died December 29, at his home in Llewellyn Park, West Orange, N. J. He had been in failing health for some time, the immediate cause of death being hardening of the arteries.

Mr. Jenkins was 68 years old. He was a son of Nathaniel and Mary Tucker Jenkins, and was born in Boston, Mass., in 1848. The business in which Alfred B. Jenkins was so vitally interested for upwards of forty years was founded by his father, Nathaniel Jenkins, who in 1864 first interested himself in the invention of water faucets, and opened a place of business at 52 Sudbury Street, Boston. Nathaniel Jenkins had conceived the idea of having his faucets fitted with renewable packings of rubber. To make these faucets satisfactory to his customers and users, he soon found that it would be necessary to have the packings made of a material which would stand hot water service. Compositions which would withstand any degree of heat were then unknown, and rubber manufacturers to whom he applied informed him that they could not be had.



ALFRED B. JENKINS.

As he could not purchase, he decided to manufacture. He went to the public library, and made a study of rubber and methods of mixing compounds, and installed in one of the lofts at 52 Sudbury Street a rubber vulcanizer and other necessary apparatus. After several years of experimenting, he invented a rubber compound which would not only stand hot water, but also *steam*. He also invented a steam valve, and obtained a U. S. patent thereon in 1866, as well as several medals and diplomas from the Massachusetts Charitable Mechanics Institute. The faucets then had little attention as all his efforts were now devoted to the production of a valve for steam service, and the manufacture of packing suitable for steam and hot water joints.

During 1866 and 1867, several additional U. S. patents were granted him for inventions or improvements in valves and packing, and, after various types had been tried, he invented and in October, 1868, obtained a patent on the type of valve which is now known all over the world as the Jenkins valve.

The corner stone having been laid, the next step was the introduction of the goods. With very little capital and an entirely new field of business and with very few acquaintances in the trade, it is not surprising that slow progress was made at the start.

In 1868 Charles Jenkins was taken into partnership with his father, and so continued until the death of Nathaniel Jenkins in 1872, when, to continue the business, his two sons Charles and Alfred B. Jenkins formed a co-partnership under the firm name of Jenkins Bros.

Their store was then located at 104 Sudbury Street, Boston, and it was there that Alfred B. Jenkins first commenced to sell valves. It was an uphill fight from the start, as the valves were a novelty to the trade, and it had to be demonstrated that the discs would successfully withstand steam. Having early decided that the valves should be of superior quality, and adopting a strong guarantee of satisfaction to the user, with the persistent efforts of Alfred B. Jenkins, who did most of the traveling and selling at that time, it was not long before the valves received the indorsement of users, and their sale increased.

On May 1, 1880, their first branch store was opened in New York; in 1885 a branch store was opened in Philadelphia; and in 1886 a branch was opened in Chicago.

The partnership existing between Charles and Alfred B. Jenkins was terminated in 1896, when Alfred B. Jenkins became sole owner of the business of Jenkins Bros., and continued to trade under the old-established name.

To take care of the Canadian business it was deemed advisable to have a factory in Canada, and in 1906 Jenkins Bros., Limited, was incorporated under the laws of the Dominion of Canada, and a modern factory erected in Montreal. A number of the employees of Jenkins Bros. were given the privilege of subscribing to the capital stock of the new company, and the balance retained by Alfred B. Jenkins.

In the year 1907, the business of Jenkins Bros. in the United States was incorporated under the same title. A portion of the stock was distributed among his employees, while Mr. Jenkins remained at the head as president, and so continued up to the time of his death.

He is survived by his widow and one daughter, Mrs. Farnham Yardley.

Death of Alfred E. Kenrick.

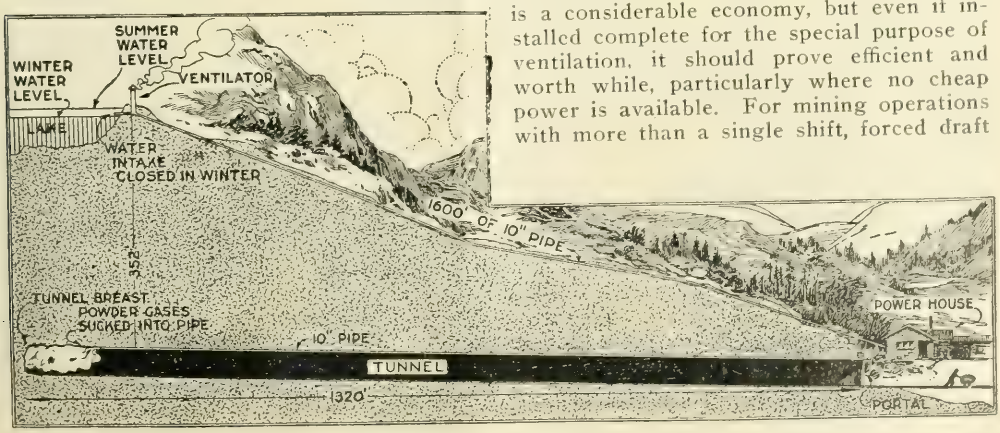
Alfred E. Kenrick, a former president of The American Society of Heating and Ventilating Engineers and of the National Association of Master Steam and Hot Water Fitters, died at his home in Brookline, Mass., January 17. Mr. Kenrick was 66 years old. His entire business career was spent in the heating and plumbing business; he was the sole survivor of the firm of Kenrick Bros., of Brookline. Mr. Kenrick had attended every annual convention of the national master fitters' association since its organization 27 years ago. On his "25th anniversary" in Chicago two years ago he was presented by the association with a silver testimonial, consisting of a silver pitcher and salver. For many years Mr. Kenrick was a director of the Brookline Savings Bank. He was one of the original stockholders of the Heating and Ventilating Magazine Company.

Ventilating a Mine Tunnel.

Excellent ventilation was provided in a mine during the winter seasons, with one shift working, by the installation of the pipe system shown in the sketch. During the summer water power is available from a lake 352 ft. above the tunnel, this fall operating a compressor and water wheel, a 10-in. fan providing air for use at the forge and in the mine. In the winter the water from the lake is not available, and this source of power is cut off until the melting of the snow raises the water in the lake basin.

To provide ventilation in winter, the 10-in. ventilation pipe is connected with the 10-in. water pipe, the water intake being closed. A standpipe with a ventilator head is provided at the lake end of the water pipe, as shown in the illustration. The air moves freely from the ventilator, being aided by the action of the wind, and the fact that the warm air at the tunnel breast will have a tendency to rise in the pipe. The pipe line from the power house to the lake is 1,600 ft., the tunnel is cut into the hillside 1,320 ft., and 100 ft. of pipe was required to connect the line from the portal of the tunnel to the lower end of the water pipe. After blasting down the rock, the powder fumes come from the ventilator quickly, and by morning, when the shift is ready to resume operations, the entire mine—2,400 ft. of workings, closed stopes, or chambers in which the rock is blasted from overhead, with manways, and 50 ft. of stoping—is clear of gas and thoroughly ventilated.

This ventilating system was inexpensive under the conditions, and is suggestive for adaptation in many other similar mining or tunneling operations. The fact that the water pipe is used for a ventilating shaft is a considerable economy, but even if installed complete for the special purpose of ventilation, it should prove efficient and worth while, particularly where no cheap power is available. For mining operations with more than a single shift, forced draft



NOVEL METHOD OF VENTILATING MINE.

would be necessary to provide adequate ventilation. The pipes should be run up to a sufficient height for proper draft, by the shortest route available.—*George N. Steuart, in Popular Mechanics.*

◆

Sales Meeting of Warren Webster & Company.

Following the recent annual meeting of The American Society of Heating and Ventilating Engineers, in New York, which was attended by many branch managers and representatives of Warren Webster & Co., the annual sales meeting of the company's representatives was held at the Hotel Astor, New York, January 18. The keynote of the meeting was co-operation—with the professional engineer, with the architect, with the heating contractor and with the owners. Several papers on these topics were read and discussed.

1423 buildings were equipped with the Webster system in 1916.

The following branch managers and representatives were present, the figures in parenthesis indicating the year each became associated with Warren Webster & Co.:

Warren Webster, president (1888); H. H. Fielding, Denver (1890); J. A. Robinson, Pittsburgh (1891); R. L. Claypool, Philadelphia (1892); J. A. Serrell, New York (1894); T. R. Schenck, New York (1895); W. C. Green, Cincinnati (1898); F. H. Stevens, assistant treasurer (1898); W. M. Treadwell, New York (1899); H. Newman, New York (1900); William H. Chenoweth, Jr., Chicago (1901); Theodore Weinshank, Indianapolis (1902); John B. Dobson, Atlanta (1902); E. K. Lanning, assistant secretary (1903); H. C. Beatty, manager engineering department (1903); R. G. Brown, New York (1903); F. G. Phegley, Cleveland (1904); F. H. Ross, Wilkes-Barre (1904); C. A. Kopf, New York (1904); William G. Snow, Boston (1905); J. L. Fitts, superintendent (1906); S. E. Fenstenmaker, Indianapolis (1906); L. C. Quackenboss, New York (1906); Benjamin Natkin, Kansas City (1908); George Eagan, Philadelphia (1908); George Westerfield, Houston (1909); E. K. Webster, secretary and assistant general manager (1910); W. F. Bilyeu, manager feed water department (1910); R. B. Stanger, Pittsburgh (1910); A. B. Knight, Detroit (1913); R. B. Beahm, Philadelphia (1914); R. T. Coe, Rochester (1915); S. B. Strouse, Atlantic City (1915); C. A. Heilman, Washington (1915); Arnold Webster, Camden (1916); E. P. Bradley, St. Louis (1916); John Jay,

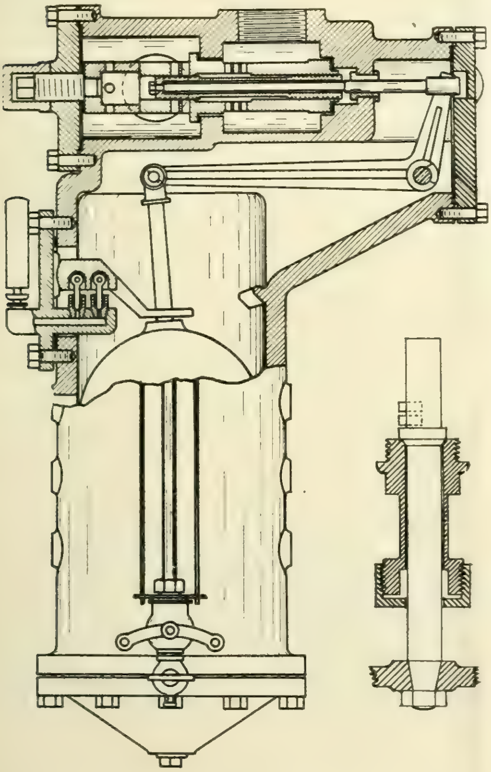
SALES MEETING DINNER OF WARREN WEBSTER & COMPANY REPRESENTATIVES.

Camden (1916); Richard Dawson, Montreal, Can.; H. J. Church, Toronto, Can.; and C. Sargent, Winnipeg, Can.

◆

Development of the Ray Continuous-Flow Feed-Water Regulator.

The accompanying illustration shows all the essential parts of a combined safety water-column and a continuous-flow feed-water regulator which has been gradually evolved by the Ray Mfg. Co., Louisville, Ky. The principle employed consists of a perfectly-balanced valve operated by a float, the feed water being admitted to the valve on its center and discharged on one end. The water should pass through the valve in a continuous flow in exact ratio to the evaporation. The regulators are furnished in five sizes, ranging from 2-in. to 4-in.



DETAILS OF THE RAY CONTINUOUS-FLOW FEED-WATER REGULATOR.

The high and low alarm whistle is operated by the same float that operates the regulating valve by having two contact points on the float rod to engage the whistle lever. The whistle lever is counter-balanced so that it holds the whistle valve closed when pressure is off the boiler.

Several interesting mechanical improvements have recently been made in this regulator. These refer to the valve bushing, strainer and support. The bushing, which was originally pressed into the head is now made loose in head and held in place by a jack screw in the valve chamber head. This bushing seats in head on two gaskets, one at the end and the other on a shoulder to prevent the passing of water except through the ports in bushing and through valve. This construction allows the bushing to be easily removed. Also, the valve bushing now serves the double purpose of a cylinder for the valve to work in and as a strainer to prevent the foreign matter from entering the valve.

Another improvement is that each regulator is now equipped with a device so that the high and low water alarm whistle can be made to blow regardless of the height of water in the column or the work that the boiler is doing.

◆

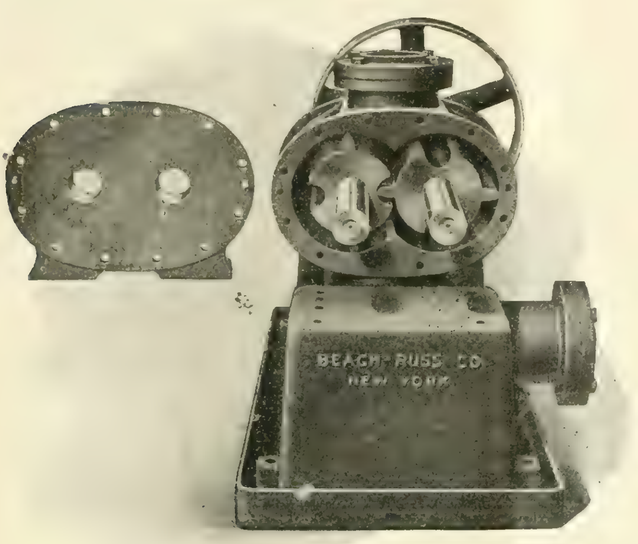
Notable Activity in the Vacuum Pump Line.

An indication of the increasing demand for vacuum pumps for use in heating work is furnished by the Beach-Russ Co., New York, which states that the sales of its special return line rotary valveless pumps have grown to such an extent that the company plant is now operating day and night. This company has been manufacturing pumps for 26 years, specializing on high-vacuum pumps, such as those used in electric lamp exhausting laboratories; also on pumps for air-line vacuum heating, etc. The company's return line vacuum heating pump, which is shown in the accompanying illustration, was brought out about six years ago. It is made without valves, cams, springs or leather, and has but two moving parts, the impellers. These impellers, however, have no contact so that there is neither friction or wear in their operation. They are separated by accurate-gauged clearance and are driven by wide-faced gears in the housing, with six ring oiling bearings lined with Babbitt metal. The pump is mounted on a heavy cast-iron drip-pan base. The gears, which have wide faces, run in oil, with dust-proof housing.

The clearances of impellers is automatically sealed with a small amount of water or condensation. In vacuum heating the condensation is found sufficient for this seal.

From tests made in actual operation, the company reports that these pumps have exhausted as high as 17 in. of vacuum, although for vacuum heating 7 in. to 10 in. is all that is necessary.

Return line pumps, it is pointed out, should have air chambers on the suction and discharge sides. These are usually made from a piece of pipe one size larger than the openings in the pump, and the pipe should be 3 to 4 ft. high, with a cap on top of the pipe.



BEACH-RUSS RETURN LINE ROTARY VALVELESS VACUUM PUMP.

The company emphasizes the importance of making sure that the vacuum return line valves are tight against leakage of steam. Sometimes these valves collapse, in which case steam is pulled through the pump, killing the vacuum. If a return-line pump is not giving the desired amount of vacuum, the valves should be looked after and the ones that have collapsed should be replaced by new ones.

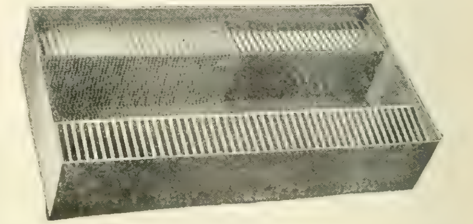
The Beach-Russ Company's engineering force, it is stated, is always available without cost for the study and solution of vacuum heating problems.

Trade Literature.

Humidity and Temperature Regulating Devices is the title of a new bulletin (No. 102) in a remarkable series of engineering treatises which are being issued by the Carrier Engineering Corporation, New York. The new bulletin contains 48 pages of description and illustrations of controlling devices to meet all commercial requirements for air conditioning. The introductory pages explain how a system of control is dependent upon various factors, chief of which are the number and sizes of rooms, their contents, arrangement of machinery, source of heat and moisture, effect of air currents and the exact humidifying, dehumidifying, heating, cooling and drying or combination of these to be accomplished. A copy of this bulletin may be had free on application. Size 6 x 9 in. (standard). Pp. 48 (punched for binding).

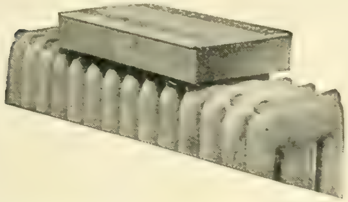
Buddington Humidifiers, designed to be placed on radiators and registers to add moisture to the air in heated rooms, are interesting devices described and illustrated in circular matter issued by the Reid-Geisler Mfg. Co., 336 West Madison St., Chicago. It is stated that with a hot radiator this humidifier will evaporate a gallon of water in 12 hrs. Perforated wings hold specially-woven wicks out from each side of the water container. One edge of each wick is in the water. The other is out on the wings through

BUDDINGTON HUMIDIFIER WITH COVER.



BUDDINGTON HUMIDIFIER WITH COVER REMOVED.

which is drawn the warm air, thus aiding the evaporation. Capillary attraction draws water up through the wicks. The wicks are wet on the wings as long as there is water in the container. The device is listed at $3.00.

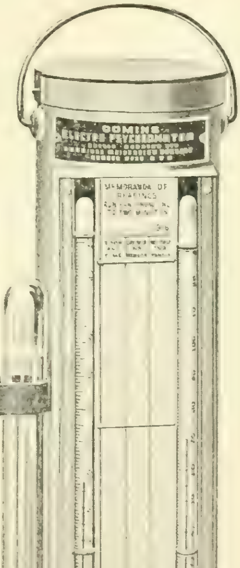


BUDDINGTON HUMIDIFIER INSTALLED ON RADIATOR.

Twenty-eight Years of Steel (National) Pipe Progress is presented graphically in a bulletin just published by the National Tube Co., Pittsburgh, Pa. A series of illustrations is included, showing similar progress in other lines of manufacture and thus indicating the tremendous advances in every line, but in none is the advance more spectacular than in the manufacture of steel pipe. Steel pipe was first made in 1887, the tonnage for that year being 300 tons. To-day, it is pointed out, steel pipe represents almost 90% of the total tonnage of screw-joint pipe made in this country, a substantial portion of which is "National" pipe. The full story of the rise of steel pipe, it is announced, is contained in "National" Bulletin No. 24, a copy of which may be had by addressing the National Tube Company.

Cochrane Heaters for Steam Power Plants, as used in heating, metering and softening water for boiler-feed and other purposes, are treated at length in a new publication (Catalogue No. 710), recently issued by the Harrison Safety Boiler Works, 3189 North 17th St., Philadelphia, Pa. The booklet is devoted especially to the uses of open heaters for the purposes stated. The amount of fuel that can be saved by the use of exhaust steam is first explained and a convenient diagram is given by which the percentages of fuel saving in any given case can be easily ascertained. The essential parts of an open feed-water heater are then considered, after which there are chapters on heating boiler feed in condensing steam power plants, including various arrangements to be used where the exhaust steam is excessive or deficient, the effects of open heaters in connection with exhaust steam heating and drying systems, the heating of water for purposes other than boiler feed, such as hot water heating, etc. Finally there is a detailed comparison of the open heater, as represented by the Cochrane feed-water heater, with the closed or pressure type of heater, concluding with suggestions for the specification of an open feed-water heater. Size 6 x 9 in. (standard). Pp. 100.

Comins Electric Psychrometer, for determining the humidity of the atmosphere, made by the American Moistening Co., Boston, Mass., is described and illustrated in its latest form in a new circular issued by the manufacturers. One of the important advantages mentioned in connection with this instrument is that if it can be used in crowded spaces among machinery where the need of readings is often greatest. Only one or two minutes, it is stated, are required for correct readings at any point. No special experience is required to take accurate readings with this instrument beyond ordinary attention and it does not need any greater care than the stationary



COMINS ELECTRIC PSYCHROMETER.

hygrometer. In both cases the wick for the wet bulb must be kept in proper condition. The circular contains some suggestions for the care and preparation of the wet-bulb thermometer and there are also included some handy psychrometric tables. Size 3½ x 6 in. Pp. 16.

Sims Steam-Tube Storage Heaters, for laundries, hotels, hospitals, and apartment buildings is the title of the latest bulletin (L-4) issued by the Sims Co., Erie, Pa. Special attention is paid to installations requiring large quantities of hot water, with live or exhaust steam as the heating medium. The catalogue is notable for the omission of all superfluous matter, no argument being presented to convince the reader of the quality of the Sims products. It is stated, however, that all work is guaranteed. The catalogue gives the general specifications for this type of heater, which is known as the Sims B-H heater, and these are followed by a series of 18 tables covering a sufficiently wide range of sizes and capacities to meet closely any combination that may be called for. Full directions are given for using the tables, by which answers may be obtained to problems like the following: To heat 250 gal. per hour from 50° to 180° F., with steam at atmosphere, providing storage for 150 gal. Another example which may be answered by the tables is the following. To heat 5,000 gal. per hour from 50° to 180° F., with steam at 50 lbs. pressure, storage 1,500 gal. The concluding pages are devoted to illustrations, with tables of connections, of the Sims B-H heater of different types. Size 6 x 9 in. (standard). Pp. 32.

Metaphram Damper Regulators, for high pressure, low pressure, hot water and vapor, embracing the complete line of these devices, are presented in new circular matter issued by the National Regulator Co., Chicago, Ill. The line embraces five types: Type H-P 7-in. for high pressure; Type A-Jr. 4-in., for low pressure; Type A 4-in., also for low pressure; Type B-C 7-in., for low pressure or vapor; and Type D 10-in., for vapor. These regulators are all metal, dust proof, and sensitive. They are guaranteed for the life of the boiler. The universal adjustment feature makes them applicable for pressure or vapor by changing the fulcrum position and shifting the weights and lever. They are made to fit any style of low pressure boiler and to work on ounces from 0 to 15 lbs. pressure, and on hot water at 5° change in temperature. The high pressure type is designed to operate on boiler pressures from 15 to 175 lbs.

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B. T. U. Losses for Various Types of Construction

In the computation of heating requirements for buildings the first requisite is to ascertain the maximum probable heat loss per hour under extreme weather conditions. To a great extent the finer graduations in such calculations may be safely avoided, but for those who may desire to be absolutely correct the following tables have been prepared giving the heat loss co-efficient for 1 sq. ft. per degree F. per hour and also the calculating factors for a temperature difference from 35° to 80° F. for each co-efficient. The figures given in the tables are based on the practice of the German government, the United States government, as well as on the practice of several well-known American Engineers.

In the modern building refinements of the wall factor are not usually of great moment, owing to the larger proportion of glass surface now being used and the relatively greater heat loss of the glass. Therefore, care in computing the window and door areas, the window factor, and the allowance for exposure and leakage are the more essential items.

It is often the case, however, where combinations of construction are encountered, either in materials or in the combined thicknesses, that even approximate factors are not available; in such cases the factor may be developed if the factor is known of each of the two materials in the thicknesses used. The combined resistance of the two is then the sum of the resistances of each and the resistance is the reciprocal of the transmission factor.

Thus, if 20-in. brick transmits 16 B.T.U. at 70° F. difference, its resistance is 1/16. And if 12-in. stone at 70° F. difference transmits 35 B.T.U., its resistance is 1/35. The two combined into a wall will have a combined resistance of 1/16 plus 1/35, or 51/560 and the transmission factor is the reciprocal of the resistance or 11 B.T.U. per hour.

With glass and skylight it is desirable to consider single thickness in all cases, owing to the fact that the single thickness may be substituted by the building contractor without the knowledge of the owner, or it may be substituted by the owner to save cost, or, even if double thick be installed at first, it may in time become broken and be replaced with single-thickness glass.

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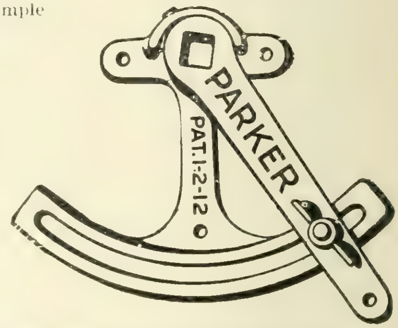

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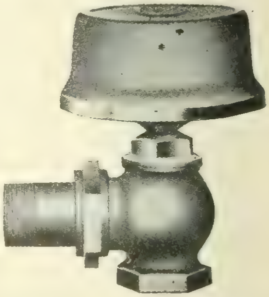

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HEAT LOSS CO-EFFICIENTS (CE).

(B.T.U. loss per square foot, per degree F., per hour.)

Brick Wall Thickness in inches Plain.	CE	Temperature Difference, Deg. F.									
		35	40	45	50	55	60	65	70	75	80
4	0.68	23.8	27.2	30.6	34.0	37.4	40.8	44.2	47.6	51.0	54.4
8	0.40	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0
12	0.31	10.8	12.4	13.9	15.5	17.0	18.6	20.1	21.7	23.2	24.8
16	0.26	9.1	10.4	11.7	13.0	14.3	15.6	16.9	18.2	19.5	20.8
20	0.23	8.0	9.2	10.3	11.5	12.6	13.8	14.9	16.1	17.2	18.4
24	0.20	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
28	0.18	6.3	7.2	8.1	9.0	9.9	10.8	11.7	12.6	13.5	14.4
32	0.16	5.6	6.4	7.2	8.0	8.8	9.6	10.4	11.2	12.0	12.8
36	0.12	4.2	4.8	5.4	6.0	6.6	7.2	7.8	8.4	9.0	9.6
Plastered Inside.											
4	0.70	24.5	28.0	31.5	35.0	38.5	42.0	45.5	49.0	52.5	56.0
8	0.42	14.7	16.8	18.9	21.0	23.1	25.2	27.3	29.4	31.5	33.6
12	0.33	11.5	13.2	14.8	16.5	18.1	19.8	21.4	23.1	24.7	26.4
16	0.25	8.7	10.0	11.2	12.5	13.7	15.0	16.2	17.5	18.7	20.0
20	0.23	8.0	9.2	10.3	11.5	12.6	13.8	14.9	16.1	17.2	18.4
24	0.21	7.3	8.4	9.4	10.5	11.5	12.6	13.6	14.7	15.7	16.8
28	0.19	6.6	7.6	8.5	9.5	10.4	11.4	12.3	13.3	14.2	15.2
32	0.17	5.9	6.8	7.6	8.5	9.3	10.2	11.0	11.9	12.7	13.6
36	0.13	4.5	5.2	5.8	7.1	7.8	8.4	9.1	9.7	10.5	11.2
One Side Furred and Plastered.											
4	0.56	19.6	22.4	25.2	28.0	30.8	33.6	36.4	39.2	42.0	44.8
8	0.30	10.5	12.0	13.5	15.0	16.5	18.0	19.5	21.0	22.5	24.0
12	0.23	8.0	9.2	10.3	11.5	12.6	13.8	14.9	16.1	17.2	18.4
16	0.20	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
20	0.18	6.3	7.2	8.1	9.0	9.9	10.8	11.7	12.6	13.5	14.4
24	0.16	5.6	6.4	7.2	8.0	8.8	9.6	10.4	11.2	12.0	12.8
28	0.14	4.9	5.6	6.3	7.0	7.7	8.4	9.1	9.8	10.5	11.2
32	0.12	4.2	4.8	5.4	6.0	6.6	7.2	7.8	8.4	9.0	9.6
Plastered Two Sides											
4	0.43	15.0	17.2	19.3	21.5	23.6	25.8	27.9	30.1	32.5	34.4
8	0.33	11.5	13.2	14.8	16.5	18.1	19.8	21.4	23.1	24.7	26.4
12	0.26	9.1	10.4	11.7	13.0	14.3	15.6	16.9	18.2	19.5	20.8

NOTE—For brick and sandstone see "Combinations" Sheet No. 1-C.

Announcement

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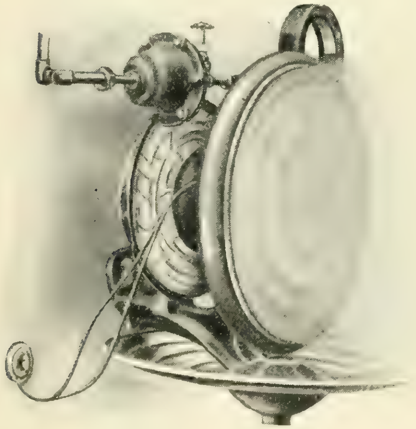

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STONE WALL Thickness in Inches.											
Limestone, Plain.											
12	0.49	17.1	19.6	22.0	24.5	26.9	29.4	31.8	34.3	36.7	39.2
16	0.46	16.1	18.4	20.7	23.0	25.3	27.6	29.9	32.2	34.5	36.8
20	0.41	14.3	16.4	18.4	20.5	22.5	24.6	26.6	28.7	30.7	32.8
24	0.37	12.9	14.8	16.6	18.5	20.3	22.2	24.0	25.9	27.7	29.6
28	0.33	11.5	13.2	14.8	16.5	18.1	19.8	21.4	23.1	24.7	26.4
32	0.29	10.1	11.6	13.0	14.5	15.9	17.4	18.8	20.3	21.7	23.2
Sand Stone, Plain.											
12	0.50	17.5	20.0	22.5	25.0	27.5	30.0	32.5	35.0	37.5	40.0
16	0.45	15.7	18.0	20.2	22.5	24.7	27.0	29.2	31.5	33.7	36.0
20	0.40	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0
24	0.36	12.6	14.4	16.2	18.0	19.8	21.6	23.4	25.2	27.0	28.8
28	0.32	11.2	12.8	14.4	16.0	17.6	19.2	20.8	22.4	24.0	25.6
32	0.28	9.8	11.2	12.6	14.0	15.4	16.8	18.2	19.6	21.0	22.4

NOTE—Some authorities use losses for stone of 60% more than brick.

CONCRETE WALL Plain											
4	1.07	37.4	42.8	48.1	53.5	58.8	64.2	69.5	74.9	80.2	85.6
6	0.70	24.5	28.0	31.5	35.0	38.5	42.0	45.5	49.0	52.5	56.0
8	0.51	17.8	20.4	22.9	25.5	28.0	30.6	33.1	35.7	38.2	40.8
12	0.43	15.0	17.2	19.3	21.5	23.6	25.8	27.9	30.1	32.5	34.4
16	0.36	12.6	14.4	16.2	18.0	19.8	21.6	23.4	25.2	27.0	28.8

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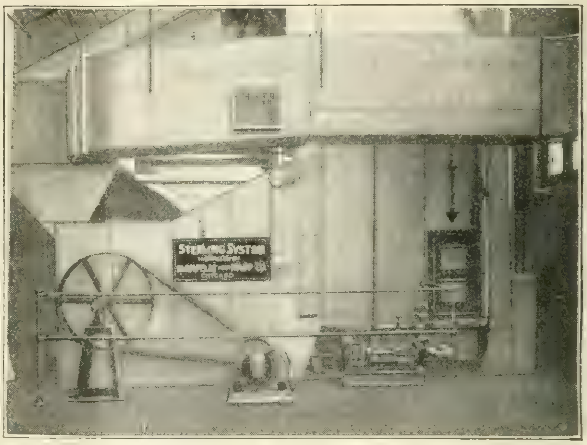

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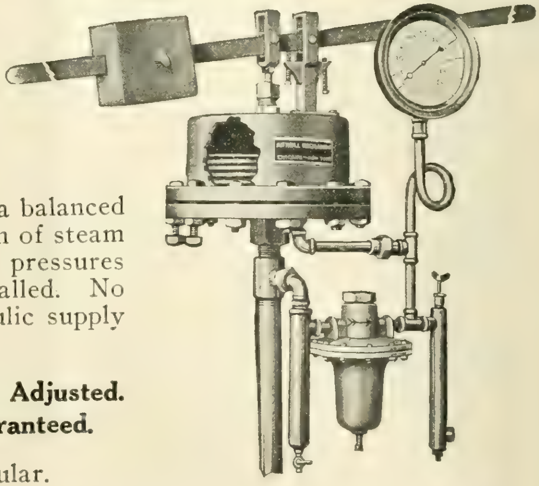

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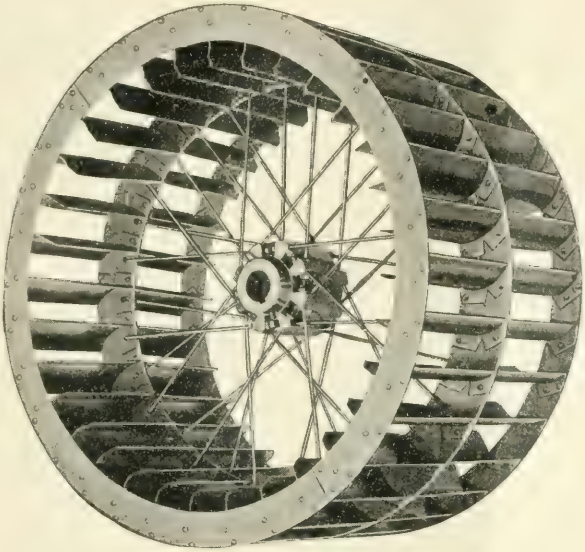
CONCRETE AND SANDSTONE WALL Thickness in Inches.	Plain.										
12	0.45	15.7	18.0	20.2	22.5	24.7	27.0	29.2	31.5	33.7	36.0
16	0.39	13.6	15.6	17.5	19.5	21.4	23.4	25.3	27.3	29.2	31.2
20	0.35	12.2	14.0	15.7	17.5	19.2	21.0	22.7	24.5	26.2	28.0
24	0.31	10.8	12.4	13.9	15.5	17.0	18.6	20.1	21.7	23.2	24.8
28	0.28	9.8	11.2	12.6	14.0	15.4	16.8	18.2	19.6	21.0	22.4
32	0.26	9.1	10.4	11.7	13.0	14.3	15.6	16.9	18.2	19.5	20.8

BRICK AND SANDSTONE WALL											
4-in. Br. and 4-in. Ss.	0.31	10.8	12.4	13.9	15.5	17.0	18.6	20.1	21.7	23.2	24.8
4-in. Br. and 8-in, Ss.	0.29	10.1	11.6	13.0	14.5	15.9	17.4	18.8	20.3	21.7	23.2
4-in. Br. and 12-in. Ss.	0.26	9.1	10.4	11.7	13.0	14.3	15.6	16.9	18.2	19.5	20.8
8-in. Br. and 4-in. Ss.	0.22	7.7	8.8	9.9	11.0	12.1	13.2	14.3	15.4	16.5	17.6
8-in. Br. and 8-in. Ss.	0.20	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
8-in. Br. and 12-in. Ss.	0.19	6.6	7.6	8.5	9.5	10.4	11.4	12.3	13.3	14.2	15.2
12-in. Br. and 4-in. Ss.	0.17	5.9	6.8	7.6	8.5	9.3	10.2	11.0	11.9	12.7	13.6
12-in. Br. and 8-in. Ss.	0.16	5.6	6.4	7.2	8.0	8.8	9.6	10.4	11.2	12.0	12.8
12-in. Br. and 12-in. Ss.	0.15	5.2	6.0	6.7	7.5	8.2	9.0	9.7	10.5	11.2	12.0
16-in. Br. and 4-in. Ss.	0.21	7.3	8.4	9.4	10.5	11.5	12.6	13.6	14.7	15.7	16.8
16-in. Br. and 8-in. Ss.	0.20	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
16-in. Br. and 12-in. Ss.	0.19	6.6	7.6	8.5	9.5	10.4	11.4	12.3	13.3	14.2	15.2
20-in. Br. and 4-in. Ss.	0.20	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
20-in. Br. and 8-in. Ss.	0.19	6.6	7.6	8.5	9.5	10.4	11.4	12.3	13.3	14.2	15.2
20-in. Br. and 12-in. Ss.	0.17	5.9	6.8	7.6	8.5	9.3	10.2	11.0	11.9	12.7	13.6
24-in. Br. and 4-in. Ss.	0.17	5.9	6.8	7.6	8.5	9.3	10.2	11.0	11.9	12.7	13.6
24-in. Br. and 8-in. Ss.	0.16	5.6	6.4	7.2	8.0	8.8	9.6	10.4	11.2	12.0	12.8
24-in. Br. and 12-in. Ss.	0.14	4.9	5.6	6.3	7.0	7.7	8.4	9.1	9.8	10.5	11.2
28-in. Br. and 4-in. Ss.	0.16	5.6	6.4	7.2	8.0	8.8	9.6	10.4	11.2	12.0	12.8
28-in. Br. and 8-in. Ss.	0.14	4.9	5.6	6.3	7.0	7.7	8.4	9.1	9.8	10.5	11.2
28-in. Br. and 12-in. Ss.	0.13	4.5	5.2	5.8	6.5	7.1	7.8	8.4	9.1	9.7	10.4



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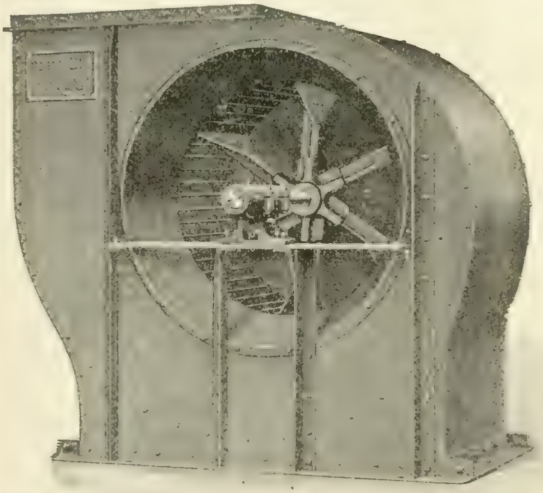

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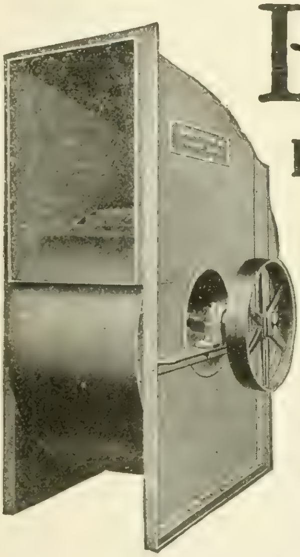

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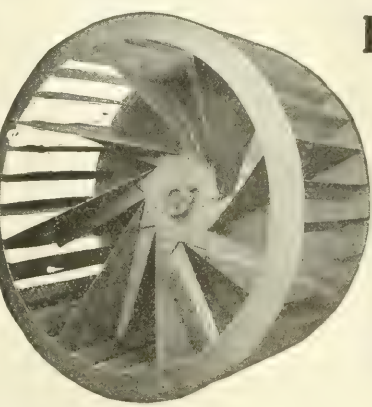

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J. S. Chapman & Co., 89 Jarvis St., Toronto, Ont.
Schellhammer & Co., Warren Pa.
H. Carlton Hewitt Co., 1105 Walnut Ave., Cleveland, O.
The O'Keefe-Hayward Co., 1932 Dime Bank Bldg., Detroit, Mich.
Sink & Edwards, 519 Massachusetts Ave., Indianapolis, Ind.
J. M. Miller Sales Co., 2008 McKinney Ave., Dallas, Texas.
Eagle Roofing & Art Metal Works, 203 Cass St., Tampa, Fla.

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Chimneys: Their Design and Construction

I. Common Chimney Faults.

By HAROLD L. ALT.

Chimneys are one of the oldest and most useful inventions conceived by man. They are of greater and more fundamental importance than anything that any modern inventor has contrived. In a primitive form they are almost as old as the human race, for a fire could not be made to burn with any regularity, nor the smoke kept from being a nuisance, without a draft. The first chimneys were probably natural crevices in the rocks forming the walls and roofs of caverns which were used for human habitation at that period.

Later stones were piled together to form rude chimneys somewhat as a camper piles them to-day to cook his food. Indian wigwams were commonly turned into very smoky and ineffective chimneys during cold weather by making an opening at the apex of the tent and lighting a fire on the ground in the center.

It takes engineering ability to make a good chimney, and one must understand the laws of Nature which apply to their construction and operation. Modern factory chimneys are triumphs of scientific construction, being built tall in order to maintain a large, hot fire, and the heated air and gases pour up through some of them with the velocity of a small hurricane at the rate of thirty-five to forty miles an hour.

Each one of us is directly affected by the sizes of the chimneys used in the world to-day, many of the trials and tribulations of our journey through this vale of tears being directly traceable to them. This, however, is not so much the fault of the chimneys as it is of the persons who build them and either deliberately transgress Natures laws or are largely ignorant of them.

MOST COMMON ERROR IN CHIMNEY WORK.

The most common error made in regard to chimneys is that of not distinguishing between the size (which governs the volume of smoke they can handle) and the height (which determines the intensity of the draft). A chimney may be *high* enough yet with an *area* too *small* to do the work required. On the other hand it may be *large* enough but too *low* to produce a *draft* of the strength required to pull the air through the fire and up the chimney at a sufficiently rapid rate. Either fault, or a combination of both, will result in unsatisfactory service and will require remedying.

BASIC PRINCIPLE INVOLVED.

The easiest way to understand the

operation of a chimney is to consider the great laws of Nature governing its operation—for there is, indeed, nothing so very mysterious about the process. The same force which supports the toy balloon and operates the hot air furnace causes the draft in the chimney. This is the simple fact that heated air expands and occupies a greater volume than the other air of a lesser temperature. Therefore, if a cubic foot of air outside the chimney weighs 0.07 lbs. and a cubic foot of the chimney gases at their higher temperature weighs only 0.04 pounds then every vertical foot of air in the chimney means an unbalanced pressure of 0.07 — 0.04 or 0.03 lbs. per square foot at the base. This unbalanced pressure has a tendency to equalize by the rising of the lighter gases, but, since their place is taken by more heated gases coming directly from the fire, the temperature, of course, never does equalize and the action continues its operation as long as the fire is kept burning.

From this basic principle all chimney action is governed and many chimney failings can be explained. For instance —the draft of a chimney is never as good in summer as in winter—because the outside air is colder in winter, the expansion of the chimney gases at the same temperature is therefore relatively greater and the intensity of the chimney draft is consequently increased.

It is a well-known trouble with chimneys that when out of use for any considerable period trouble is likely to be experienced in "starting the draft." This is easily explained by the fact that, in starting, the cold chimney will cool off the gases to a point where their temperature may be the same, or nearly the same, as the outside air, thus causing them to contract and lose their buoyancy. This, of course, immediately results in killing the draft, as the draft depends absolutely on a temperature difference and the expansion resulting therefrom.

Ordinary residence chimneys have little trouble on account of height owing to the fact that most residence heating systems burn large size anthricite coal which makes a very hot clear fire and offers little resistance to the passage of air through the fire bed. In fact, many of the older railroad stations and similar places use coal stoves with only a stove pipe extended through the roof, this pipe seldom being over 10 ft. in height. But an attempt to burn smaller sizes such as pea and buckwheat would be doomed to failure under such conditions.

The ordinary residence usually employs a chimney between 25 and 60 ft. high, the area being proportional to the size of the house and it is interesting to note that it is possible to burn No. 1 buckwheat coal with a chimney 55 ft. high if the fire bed is not made too thick. Down-draft boilers should have chimneys at least 60 ft. high to operate successfully.

COMMON CHIMNEY TROUBLES.

The more common troubles may be summarized as

(*a*) Chimney of bad shape—not approximately square or round, or with too many offsets.
(*b*) Too small a chimney.
(*c*) Too low a chimney.
(*d*) A combination of (*a*), (*b*) or (*c*).
(*e*) Too much leakage.
(*f*) Downdrafts.
(*g*) Lack of air supply for fire.
(*h*) Loose connections to chimney.
(*i*) More than one smoke pipe connected.
(*j*) Stoppage in offsets.
(*k*) Inserting smoke pipe too far into chimney.

Chimneys have to overcome their own losses, these losses consisting of the friction of the gases rubbing against the sides in their upward passage. For this reason a *circular-shaped flue* is most desirable, there being less surface exposed in comparison to the area than in any other shape. Most high stacks where the friction builds up to a considerable amount are, therefore, made round in cross section.

The next most advantageous shape is *square* and the next, after that, is *oblong* with the *long* side *not more* than *double* the length of the *short* side. In flues where it is necessary to exceed this proportion *two* separate flues of more desirable shape can sometimes be used with advantage.

With the same idea of reducing the friction of the gases on the sides it is most desirable to build a chimney flue *straight* from top to bottom as all changes in direction, or even in shape, produce an additional friction loss, as does also the condition of the interior surface. The *smoother* the surface the *less* the *rubbing* effect and for this reason the use of flue tile is advocated, this being tile flue pipe made in various forms and shapes and with a very *smooth* interior surface. Fig. 1 shows a plain brick chimney without tile and Fig. 2 the construction of a chimney using flue tile.

From the above it can be seen that *the most efficient chimney, as far as draft is concerned, is one built perfectly straight from the bottom up, round (or nearly round) in the shape of the interior flue, and lined with tile, or with the interior surface made as smooth as possible by other means.* There is no advantage in tapering the inside of a chimney to a smaller size toward the top as this retards the flow of the gases.

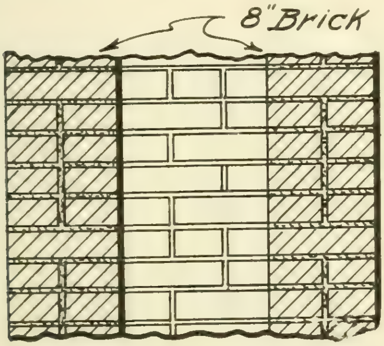


FIG. 1—PLAIN BRICK CHIMNEY WITHOUT TILE.

Having a chimney built upon desirable lines, as far as draft is concerned, it may, of course, still be too small, and in this connection it might be said that no flue should be made *less* than 8 in. diameter or 8 in. x 8 in. square. Under ordinary conditions, with steam, furnace or hot water heating, the sizes of flues given in Table I will be found to give satisfaction in residences whose cubic footage does not exceed the amounts shown.

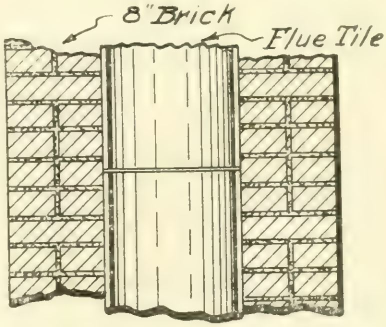


FIG. 2—CHIMNEY WITH FLUE TILE.

When flue tile is used the interior dimensions are not in even figures, the exact dimensions of commercial sizes being given in Table II.

When square or rectangular chimneys are designed for fire-places which burn wood or bituminous coal they are usually made with an area of 10% to 12% of the fire-place opening, while with round flues the area may be reduced to 8%. For anthracite coal the rectangular or square flue may be reduced to 8% and the round flue to 6%. Ordinary stoves are readily served with an 8 in. x 8 in. flue provided no other connections are made to it.

All chimney walls should be 8 in. thick to avoid danger of fire from sparks working through the joints and the building laws in some cases demand not only 8 in. thick walls but tile linings as well.

TABLE I—SIZES OF FLUES FOR RESIDENCES.

Contents of Building Cubic Feet	Round Inches Diameter	Square Inches	Oblong Inches
20,000	8	8 x 8	6 x 10
40,000	9	9 x 9	8 x 12
60,000	10	10 x 10	8 x 14
110,000	12	12 x 12	10 x 18
120,000	14	14 x 14	12 x 18
130,000	16	16 x 16	12 x 18
150,000	18	18 x 18	14 x 20

TABLE II—COMMERCIAL SIZES AND AREAS OF FLUE TILE.

Square or Oblong Outside Dimensions Inches	Circular Inside Dimensions Inches	Area Sq. In.
..	8	50
8½x8½	..	52.
..	9	64
..	10	78
8½x13½	..	80
..	11	95
..	12	113
13x13	..	126
...	13	133
13x18	14	154
..	..	169
..	15	177
..	16	201
..	17	227
18x18	..	240

ADDITIONAL ADVANTAGES OF ROUND CHIMNEYS.

There are also other advantages in building chimneys round (or nearly round) and in the use of flue tile. The gases in their progress upward do not move in a straight line but assume a swirling, spiral motion resembling the rifling of a gun barrel and in the process of aiding this movement a circular shape is best.

In fact, a *square* chimney can hardly be figured as having its full area effective, a *deduction of 10% to 15%* being necessary on account of this very movement leaving the corners dead and inactive. In an *oblong* shape the effect is worse, a *deduction of 25%* being none too much. The use of tile flues will not only aid this slightly—owing to their rounded corners—but will also safeguard much of the fire risk otherwise due to mortar falling out between the bricks as time passes and leaving openings through which a spark might pass. As the tile serves to retain the gases and smoke it also prevents leakage which can spoil a chimney action at any time, no matter how perfectly the flue may otherwise be built.

The *height* of residence chimneys, as before mentioned, is not so important where the larger sizes of anthracite coal are used. The draft, however, ought to approximate in *inches of water* the various values given in Table II-A after being in use twenty-four hours and with all the inlets suddenly closed.

The figures given are about 90% efficiency of the theoretical draft which an absolutely tight chimney would show and a properly constructed chimney should approximate these figures.

METHOD OF USING DRAFT GAUGE.

Measurement of the draft in a chimney is made by a draft gauge which in its simplest form is nothing but a glass tube of U-shape, one end of which is connected to the base of the chimney and the other end is left open to the air.

The suction or draft of the chimney will raise water placed in the tube so

TABLE II-A—DRAFT IN CHIMNEYS FOR RESIDENCES.

	Temperature of Chimney Gases, Deg. F.		
Height in Feet	200	250	300
	Inches of Water		
60	0.27	0.32	0.35
55	0.25	0.29	0.32
50	0.23	0.26	0.29
45	0.21	0.23	0.26
40	0.18	0.21	0.23
35	0.16	0.19	0.20
30	0.14	0.16	0.17
25	0.12	0.14	0.14
20	0.09	0.11	0.12

that the water in the leg connected to the chimney stands higher than that in the leg open to the atmosphere, this being due to the unbalanced pressure and proportional thereto. The difference in level between the two columns of water is measured in inches, this difference being termed the draft in "inches of water." Some draft gauges have the legs of the U inclined only a few degrees off the horizontal so that a rise of a small amount causes a large movement horizontally along the inclined tube on which finer graduations can be read.

To take a theoretical draft reading (which is the most accurate method to pursue) see that the temperature of the flue gases is known at the time of taking the reading and that a tight damper can be closed in the smoke pipe. Connect the draft gauge to the chimney, take the flue gas temperature and then quickly close the smoke pipe damper and read the draft gauge as soon as it reaches the highest fixed point.

For points above sea level the readings will be *less* than that shown in the table the percentages being for

2,000	feet,	97%
4,000	"	94%
6,000	"	92%
8,000	"	89%
10,000	"	86%

Thus, a chimney 50 ft. high and at 250° temperature at sea level should have a draft of 0.26 in., but at 6,000 ft. elevation it should have 0.26 x 92%, or 0.24.

CHIMNEY LEAKAGE.

Leakage may take place not only *through the joints* of the chimney itself but through the *connections to the chimney*. For this reason a *separate* chimney flue for every connection is advocated.

A stove on the first floor and a heating apparatus in the basement may be connected to the same flue, *if it is large enough,* and both may work satisfactorily; but put out the fire in the stove and open the doors—the inrush of cold air into the flue will *spoil the draft* for the heating apparatus, this inrush of air being simply excessive leakage into the flue all at one point.

The *leakage* may not even come from the outside air but *may come from an adjoining flue* in which case it is just as detrimental in its effect. For this reason chimneys with more than one flue should never be built without *a 4-in. brick wall between the flue tiles.* The common practice of placing flue tile close together *without this brick wall later leads to trouble* in many chimneys.

Several boilers may be connected into one flue of sufficient size if they all are properly dampered in the smoke pipe with tight dampers and if these dampers are kept closed when the boilers are out of commission.

USE OF TWO FLUES FOR ONE APPARATUS.

Questions are often asked about using two old flues for one apparatus when it is desired to make alterations in an existing building. In this regard it can be said that reasonably satisfactory operation can be secured from such an installation if the dividing partition is knocked out 5 or 6 ft. down from the top of the chimney and up to 5 or 6 ft. above the point where the smoke pipe enters the chimney. There must be no other connections to the chimney, however, and the chimney must be in good condition otherwise to serve its purpose; the best results will be obtained where the smoke pipe enters the middle of the enlarged chimney so as to distribute the hot gases as equally as possible into both flues higher up. Of course, the center partition remaining exposes just so much more rubbing surface to the gases, giving a greater friction loss and the chimney will give better service—otherwise a stronger draft if the center partition is removed entirely.

OTHER CHIMNEY DEFECTS.

Oftentimes chimney troubles are entirely due to outside causes and not to the construction of the chimney itself. The most frequent of these is the *termination of a chimney below the level* of the adjacent ridge of the roof or other nearby obstruction. Even nearby buildings or mountains may interfere with the operation of a chimney, the cause in all cases being the wind coming over the higher obstruction and dropping down onto the top of the chimney. As can be easily realized, chimney draft (after deducting the friction in the chimney, in the heating apparatus, and in the fire and smoke pipe) does not possess a very great force, and a high wind, with the air dropping down toward the top of the chimney, could readily hold back the action and, in some cases, even result in "back-drafts."

The best *remedy* for such trouble is to *extend* the chimney higher so as to get *above* the nearby ridge or building if possible. This at the same time will both prevent the wind dropping down onto the top of the chimney and will give the chimney (due to the increase of its height) a stronger draft to resist such action. If this is impractical one of the *many types of chimney tops* having side or downward outlets *will prevent "back-drafts"* but these will at the same time slightly retard the chimney action, due to the greater number of turns the gases are forced to make and the additional friction thus produced.

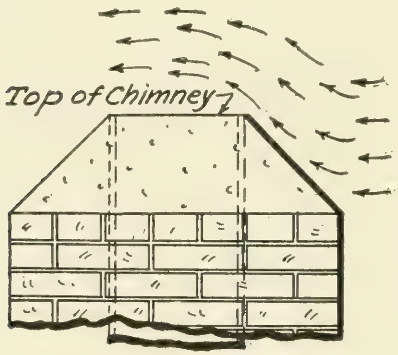


FIG. 3—GOOD TYPE OF CHIMNEY TOP.

A very *desirable type of chimney top,* where "down-drafts" are not likely to be encountered, consists of finishing off the *top at a 45% angle* all around from the flue outlet to the side of the chimney, as shown in Fig. 3. This results in deflecting horizontal winds upward when blowing across the top of the chimney and gives a slight ejector action, helping to draw the gases up and out of the chimney.

Trouble with a chimney may also be experienced on certain days when the cellar door comes on the *leeside* of the building or when the cellar is so *air tight* that sufficient air does not leak in to replace that lost up the chimney. This results in a *partial vacuum* in the cellar which vacuum reacts against the draft that would otherwise be obtained. The remedy for this is to *open a cellar window on the windward side, close the opening to the leeward,* or else *provide some means of allowing air to enter* from some other source where the wind action is not encountered.

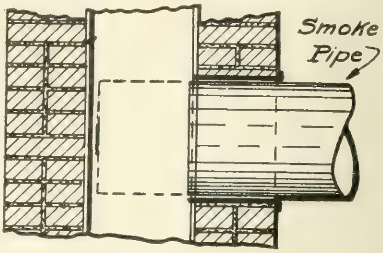


FIG. 4—HOW CHIMNEY AREA MAY BE RESTRICTED BY SMOKE PIPE.

The connection to the chimney commonly termed the *smoke pipe* is another factor which must be considered. The smoke pipe should *never be reduced below the size of that on the heating apparatus;* if more than one smoke pipe is connected into a common pipe before going into the chimney the area of the *common pipe* should have an *area equal to* the *combined areas* of the two entering pipes. A loose connection where the pipe enters the chimney, a loose fitting cleanout door or other openings leading into the chimney will act the same as a leakage from any other source.

Neither should the smoke pipe be shoved into the chimney so far as to *project into the interior opening* as shown in dotted lines—Fig. 4—since this restricts the area and if carried to an extreme will shut off the draft entirely. Every smoke pipe should have a *tight damper* operated by hand for closing down during high winds, for testing and for use when the apparatus is out of service.

Chimneys which have given good service for years and which then gradually fail to have sufficient draft usually are found to need *cleaning* and chimneys with *offsets at a sharp angle* are usually troubled in this way. A cobble stone tied to a rope and dropped down gradually from the top of the chimney, working this up and down as it goes down, will clean out many such troubles at slight expense. Gun powder in small charges ignited in the base of the chimney has also been used to jar the soot loose but this method does not come within the "safety first" limitations.

Next month the author will take up designing data for chimneys and power plant stacks. His discussion will be accompanied by friction loss charts for brick and steel stacks and a theoretical draft chart for stacks.

Remodeling the Ventilation of a Theatre

Changes Made to Overcome Overheating, Local Cold Drafts and Unsatisfactory Ventilation.

By SAMUEL R. LEWIS.

(*Presented at the annual meeting of The American Society of Heating and Ventilating Engineers, New York, January* 16-18, 1917.)

The purpose of this paper is to describe some experiences with the heating and ventilating of a very large theatre. The original plant was not satisfactory. It was changed at slight expense into a very satisfactory system by performing a comparatively small amount of labor.

The theatre is used mainly for concert purposes, being the home of an endowed orchestra. As originally installed, the plant was arranged for downward ventilation. The fresh air, taken from a point about 20 ft. above the ground, was warmed to prevent freezing, drawn through an air washer and tempering heaters to a fan, and then under pressure was delivered through an underground masonry tunnel, as shown in Fig. 1, to reheaters placed approximately under the center of the auditorium. These reheaters were placed in connection with plenum chambers in such a way that single metal ducts provided with automatic double mixing dampers, radiated from them, leading to the various flues placed around the walls. The mixing dampers in these ducts were controlled by thermostats placed in the auditorium. The air was to be removed through approximately 800 5-in. floor tubes through the first floor, which connected into chambers formed by the concrete first floor as a ceiling, the circumferential floor beams as sides and the galvanized steel bottom. These chambers, at each side of the basement, connected with metal ducts to two large vent flues, one at each end of the stage, running from the basement to the exhaust fan chamber in the attic. The illustration, Fig. 1, which is a center line section, shows the location of the inlets and outlets as follows:

Flues A: One of these is placed at each side of the stage, runs to the attic and across the attic to the rear of the house. Each has openings as follows: at A, 10 ft. above the lowest point of the first floor; at A-1, opposite the balcony, and at A-2 where each duct supplies two openings discharging diagonally through the ceiling over the gallery.

Flues B: Two on each side under the balcony discharging toward the center of the house.

Flues C: One on each side under the balcony discharging toward the stage.

Flues D: Two on each side underneath

the gallery, discharging toward the center of the house.

Flues E: One on each side under the gallery discharging toward the stage.

It will be seen that the air delivered through E strikes the beam and is deflected toward the floor. There were six large grilles around the chandeliers in the ceiling. These were connected with metal ducts to the exhaust fan and had a cross connection to the two ducts A so that the ceiling openings could be used for either supply or exhaust air.

The exhaust fan discharged into a masonry flue provided with a pneumatically-operated damper which was intended to prevent the escape of heated air when the auditorium was unoccupied.

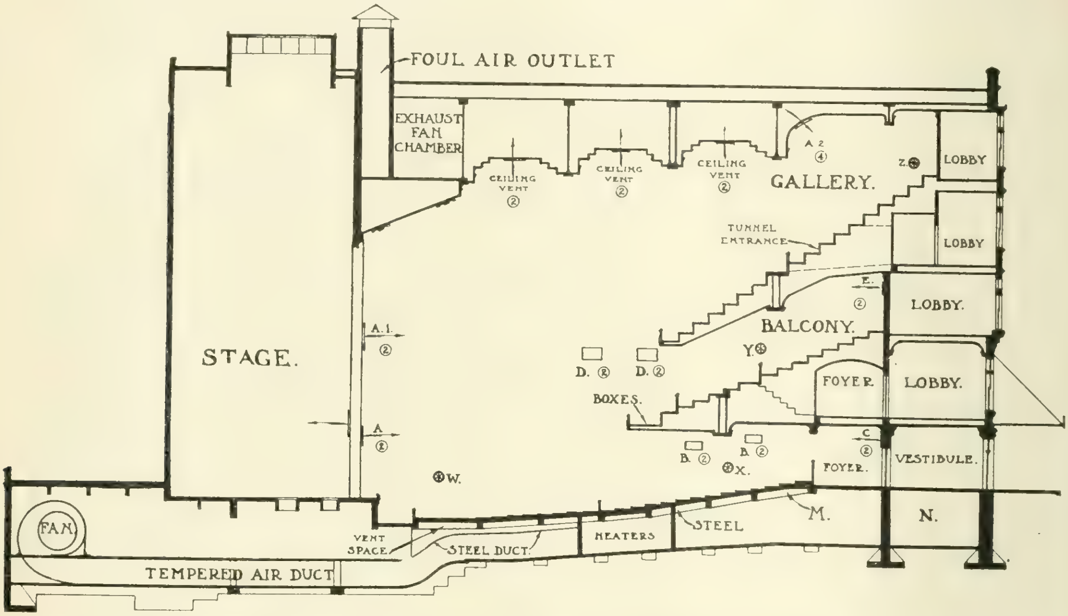


FIG. 1—LONGITUDINAL SECTION OF THEATRE BUILDING, ON CENTER LINE, SHOWING ARRANGEMENT OF AIR DUCTS AND OUTLETS.

The very tortuous duct systems in the basement and attic, comprising both fresh- and foul-air conveyors presented a very complicated appearance, and caused a very heavy frictional resistance. Very little heating effect was apparent when operating the plant without running the fans.

HEATING

The lobbies had entrances and stairways for the first floor and balcony separate from those for the gallery. They were supposed to be heated by direct radiation. The foyer had no provision for any heat at all, although there was considerable exposed wall surface. The auditorium was provided with adequate tempering, retempering and heating radiation, the latter being in six units adjacent to the plenum chambers. The heaters were encased in steel without any insulation and were hand-controlled by valves on the steam and return connections.

CONDITION AT TIME OF INSPECTION.

Some time after the plant was completed the following changes were made:

The basement ducts leading to flues E were cut off from these flues and connected so as to deliver fresh air into the former foul air chamber M, between the rear-most circumferential beam and the rear wall of the first floor. This chamber was closed off from its former connection with the foul-air collecting ducts at the side walls. The flues, E, however, were connected with these foul-air ducts. Thus, the seats in the rear panel across the house on the first floor were supplied with air by upward action through the floor openings, and the air at the rear of the balcony was exhausted at the ceiling line.

Since the exhaust fan was directly over the proscenium arch, very objectionable noise and vibration was observed throughout the building when it was operated at anywhere near its proper speed. When running the supply fan without operating the exhaust fan, it is obvious that the very long and crooked foul-air and fresh-air ducts would cause so much resistance as to result in the delivery of a woefully deficient volume. Since the fans were depended upon for both supply and exhaust, their speed must necessarily be kept in proper relation with each other. Thus it was discovered that the slow speed on the exhaust fan, and full speed on the supply fan, caused very complex and irritating drafts in many parts of the auditorium. The custom, based on experience, was to operate both fans at less than one-half speed, resulting in a volume of air being put through so reduced in quantity as to be incapable of carrying off the surplus heat from the occupants.

TEMPERATURE REGULATION.

The temperature of the tempered air used for cooling was regulated by bypass dampers under the tempering and retempering heaters controlled by duct thermostats, arranged as follows:

W—Two thermostats, one on each side near the stage, controlled the air going to flues A, most of which, it will be noted, was delivered through the openings A-2.

X—Two thermostats, one on each side at the rear of the first floor, controlled the air going through flues B and C (six dampers).

Y—Two thermostats, one on each side in the balcony, controlled the temperature of the air going to flues D. They also controlled the dampers in ducts E, which, however, owing to the change mentioned before whereby risers E became vent flues, no longer discharged into the balcony but to the floor inlets under the seats at the first floor rear (space M).

There were no thermostats in the gallery, but this highest and probably warmest part received air influenced by the thermostats W in the lowest and probably coolest part of the room down on the first floor.

It should also be noticed that the thermostats Y in the balcony, a cooler place, were controlling the air delivered to the first floor rear, a warmer place, where different requirements would be expected.

TESTS.

Early in December, some preliminary observations were made while the plant was operating in the customary manner by the regular force of employees. It had been so operated for three and a half hours prior to the observations. The following temperatures were observed:

LOCATION	TEMPERATURES, DEGREES F.
Outside	41
Main lobby	63
First foyer	59
X—first floor	69
W—first floor	64
Y—balcony	66
Rear wall at center of balcony	69
Z—gallery	66

NOTES.—As a rule it was found that the north side was 1° cooler than the south side. The temperatures mentioned are those on the north, as the inlets, thermometers and building are symmetrical.

Openings A had been closed to reduce drafts.

Openings B toward the rear (2 of them) one on each side, had been closed.

Openings E were supposed to be vents, but showed no air movement.

Openings A-2 in the gallery were being operated as outlets.

The exhaust fan was running 126 r.p.m.; the supply fan was running at 78 r.p.m.

It is evident that insufficient area was provided for fresh air inlets, and that the system must have been more an upward than a downward one.

Very objectionable drafts were felt as follows:

First Floor: Coming down all aisles from the doors into the foyer. Caused by cold air from the same falling down the stairs from the balcony and spilling out into the first floor. Note foyer temperature but 59° after 3½ hours operation at 41° outside. Perceptible down draft from rearward all around front part of orchestra.

Balcony: Draft out into foyer from center entrance evidently to supply the air spilled out on first floor; cold draft in from upper entrances, following down aisles; (the upper balcony entrances are to a cul-de-sac and cannot circulate in the manner characteristic of those elsewhere). Cold draft from rear and northward across the boxes, which follow the curve at the lowest point of the balcony; noticeable upward current across face of balcony edge from below; strong drafts from inlets D and from A-1 observed within their range.

Gallery: Strong cold draft in through center entrances from cold lobby (59°), strong draft out through rear and highest entrances to cold lobby; strong drafts from A-1.

An analysis of these drafts indicates:

1. A strong current *out* at upper communications with the foyers, and *in* at lower communications with the same.
2. Poor diffusion of air, especially from A, A-1 and A-2.
3. Insufficient heating of the lobbies and foyer.
4. Insufficient air supply to give good ventilation.
5. Insufficient exhaust to remove surplus heat.
6. Undue loss of heat into the basement from the ducts, which run through the same. (The air to support the draft of the boilers was found to be obtained to a considerable extent by pulling heated air from the auditorium basement through a communicating passage.)

Inlets A were opened and by experiment found to be unavailable. Inlets B at first closed, were also found impracticable, because of drafts.

There was a very objectionable draft from above the switchboard on the stage, although the air inlet there was found to be closed. The chilling effect on the supply flues which ran a considerable distance along a cold outside wall was noticed.

CHANGES.

An analysis of the foregoing conditions made it evident that a radical revision in the entire system was necessary. Accordingly it was decided to make quick adjustments which would bring about the following changes, as follows:

a. Abandon the exhaust fan, using upward ventilation, induced by the pressure of the supply fan (since the exhaust fan noise and vibration could not easily be overcome).

b. Use the basement as an air supply chamber, thus heating the same so as to be sure of a warm first floor.

c. Abandon inlets B, C and E. Accordingly a number of openings, each about 2 ft. square, well distributed, were cut through the foul air chamber metal bottoms, giving access for fresh air to the entire foul air chamber system, and providing for excellent distribution of the air volume.

d. Ducts leading to flues B and C were torn down, so that they opened into the basement, and the old risers were closed tight. The manhole doors into the plenum chambers were opened, to give additional air supply to the basement. A tight partition was placed in the opening which formerly communicated with the boiler room. The two large vent stacks leading from the basement to the attic were closed tight. The former gravity vent ducts to the foul air outlet in the attic were removed, so as to give a greater free area of outlet. The openings A-2 in the gallery were arranged to deliver tempered air (since no thermostats in the gallery were provided). The six ceiling openings were arranged to vent freely through the attic space to the new enlarged foul air outlets. Deflectors were placed on inlets A-1. Inlets A were closed.

TEST WITH AUDITORIUM OCCUPIED.

On the night of December 10, the auditorium was occupied for a performance. The first floor was 90% full, the balcony was 50% full, and the gallery was unoccupied. The supply fan was run full speed—130 r.p.m. The tempered air temperature was 68° F. at 8 p. m., but by 9 p. m. had been reduced gradually to 66°. The temperature throughout the house, except lobbies and foyer, did not at any time vary more than one degree from 70°. Repeated inquiries of persons in various parts of the house failed to bring to light any complaints of either temperature or drafts. The lobbies and foyer were cold. There was a draft from the rear down the aisles from the causes described above.

On the morning of December 11, a test was made, operating exactly as last described, without any changes of any kind. About 1,000 candles were distributed, one on every other seat, in order to study draft conditions simulating occupancy of all the seats, and in order to observe temperature effects. These candles were of the standard plumber's type, such as has been taken by the Chicago Commission on Ventilation as giving off approximately twice as much heat as that from one person.

The plant was not operated to full supply fan speed until 10:45 a. m. The test started at 11:00 a. m., when all candles were lighted. The temperature outside was 34° F. and the tempered air was 66°. The results were as follows:

LOCATION	TEMPERATURES, F.				
	10:45	11:00	11:15	11:30	11:45
W	66	70	70	72	70
X	65	68	71	72	70
Y	66	68	70	71	71
Center rear of balcony	..	68	72	74	76
Center front of balcony	..	68	68	71	70
Sides of balcony at front	66	67	69	71	69
Foyer, first floor	60	66	..	..	..

The candles operated 45 minutes. The heat from them was very evident. Sufficient experimenting was done to demonstrate that it is possible with all the candles lighted (paramount to full occupancy), to reduce temperature at will in any part of the house, except in the pocket at the rear of the balcony. Since no changes, in the limited time available, had been possible in the automatic temperature regulation and the same was badly involved as before described, the controlling was done by hand, to a great extent. Twelve observers were distributed around the house, watching the candle flames for drafts and observing the thermometers. No. objectionable drafts were observed anywhere except the ever-present ones down the aisles, due to the cold foyer and lobbies, as before noted.

Special attention was paid to the center balcony boxes, from which many complaints had originated. The candles burned very steadily there and no drafts or unpleasant temperatures could be found.

Some deflection was noticed in range of the temporary crude diffusers on outlets A-1. Some draft, which is inherent, due to the large cold loft over the stage and which is present in all theatres, could be seen affecting the candles at the front of the orchestra. Since this comes from the front and is gentle, and since face currents are usually pleasant, no complaint from that source was apprehended.

The velocity through the floor inlets when running the fan at full speed was in no case found to exceed 130 lin. ft. per min. and averaged not over 110 ft. per min. Some adjustment of the volume dampers was required to bring this about. There was a marked improvement in conditions behind the proscenium arch. The draft over the switchboard had disappeared. The temperatures were excellent except in the pocket at the rear of the balcony. There was no outlet from this pocket and the temperature necessarily would rise under these conditions.

PERMANENT CHANGES.

Ventilation: To ventilate the upper part of the balcony, a number of openings were cut through the ceiling near E into the fireproof space under the gallery. A 42 in. propeller fan was connected with a duct leading from this space. This settled the matter of the overheating of the balcony.

Vertical blade diffusers about 6 in. wide, 3 in. on centers, were placed on the inlets A-1 to divert the air out toward the center of the gallery. These, with an adjustment of the existing horizontal diffusers, greatly improved conditions there.

The same type of diffusers was installed on the inlets D. The exhaust fan and all of the attic ducts, except those leading from the flues A and inlets A-2, were removed.

Evenly-spaced openings were cut through the steel bottoms of all of the circumferential chambers under the first floor. These openings were provided with dampers so that the volume of air delivered could be easily adjusted.

All of the unnecessary metal ducts were removed from the basement, including the foul-air collecting ducts along the side walls.

A separate fan, heaters and ducts were provided for the main front vestibule, the fan being placed in the room marked N and arranged to recirculate the air. Thus a balanced pressure is maintained in the vestibule and there is no further difficulty due to drafts from this source, and it has been found possible to heat the room properly even when outside weather conditions were very severe.

Heating: Sufficient direct radiation was placed in the lobbies and foyers properly to heat the same. In the formerly very cold stair cases leading to the gallery a connection was made from the plenum chamber in the basement to registers behind the radiators so that these former direct radiators became indirects, and the heat given off by them was increased threefold.

Temperature Regulation: Two new thermostats were installed at Z in the gallery controlling the temperature of the air handled by the flues A, and delivered through the openings A-1 and A-2.

The thermostats Y were connected so as to control the temperature of the air handled by the flues D.

The thermostats X were changed so as to control the temperature of the air delivered into the rear part of the basement plenum chamber.

The thermostats W were changed so as to control the temperature of the air delivered into the front part of the basement plenum chamber.

Two additional thermostats were placed at W controlling progressively the steam supply to the re-heaters in the basement plenum chamber so as to preclude the possibility of overheating the air supply.

Since these changes have been made further tests have demonstrated that the heating and ventilating of this building is as satisfactory as any reasonable person could demand. The cost of heating the building has been very greatly reduced. In fact, quite satisfactory heating of the room is obtained without operating any fan at all, due to the peculiar construction which encourages gravity circulation.

Mechanical Requirements of a Modern High School Building

Schenley High School, Pittsburgh, Pa.

A month short of two years in building, the new Schenley High School, Grant Boulevard, Pittsburgh, Pa., recently opened, represents an investment of about $1,500,000. While no expense has been spared to build the best possible structure, everything else has been sacrificed in order to obtain simplicity with greatest utility. In addition to being used for school purposes during the daytime, the building is designed to serve the community in general. The building will be open for free use by the people for various community activities.

The building rests on 1,700 concrete piles, many of which are sunk 40 ft. into the ground. It is of steel and concrete construction, fireproof throughout, and faced on the exterior with Indiana limestone. Inside, it is finished in tile and oak. There are 180 rooms in the structure, including 40 classrooms, 11 laboratories, 11 shops, 4 crafts rooms, 7 domestic science rooms, 2 music rooms, a library, an auditorium, and 6 commercial and accessory rooms. In addition there is a swimming pool with 32 shower baths, separate gymnasiums for boys and girls, a suite of offices, with master clock controlling the time in 27 clocks in the building, a medical department with complete equipment, a special room for girls presided over by a school mother, a bakery, two lunch rooms, and a laundry.

The high school proper occupies three floors; the shops, gymnasiums, swimming pool and lockers occupy the basement, while the sub-basements are given over to the electrical and mechanical plant and storage space. One wing of the building is fitted up as a complete observatory. The auditorium is directly opposite the entrance, with entrances to balconies on the second and third floors. The stage is equipped with curtains and disappearing footlights. The auditorium is brilliantly lighted, as are the other parts of the building, for which purpose a total of over 2,136 watts in Westinghouse Mazda lamps are employed.

SCHENLEY HIGH SCHOOL, PITTSBURGH, PA.

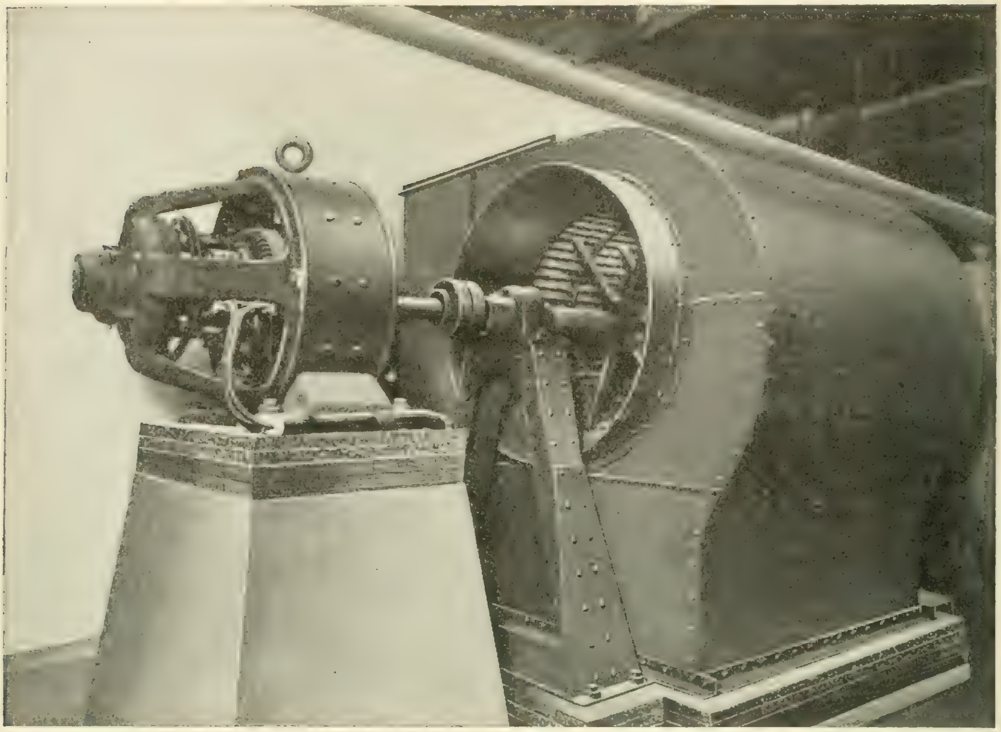
TABLET ARM CHAIRS USED IN PLACE OF DESKS.

In equipping the classrooms a radical departure has been made; the old-fashioned desk has been abolished and in its place a tablet arm chair is used, designed so that the pupil must sit in the correct hygienic position.

The general science and physics departments are provided with quarters and equipment representative of the latest practice. The science laboratory equipment is such as even very few of the universities of the country can boast. The lecture room of the chemistry department is fitted with every convenience to make complete demonstrations of experiments. Besides the lecture room, this department also has a general library, a preparing room, and other special rooms. It is also contemplated to put in force a preparatory electrical engineering course, and for this purpose a number of Westinghouse standard laboratory testing meters have been purchased.

The library, it is expected, will be maintained as a branch of the Carnegie library. The shops include a manual training department with a full complement of motor-driven planers, lathes, etc., a molding department and a complete printing plant, employing individual motor drive.

The lunch rooms will feed 1,800 students, boys and girls separately, in 30 minutes, on the caféteria plan. The kitchen is the most completely equipped of any of the school kitchens in the United States, and has many electrically-driven appliances, such as dishwashers, potato peelers, and food choppers. The cooking can be done by gas or steam, or by means of two 12-gallon fireless cookers. The bakery, where 100 dozen rolls

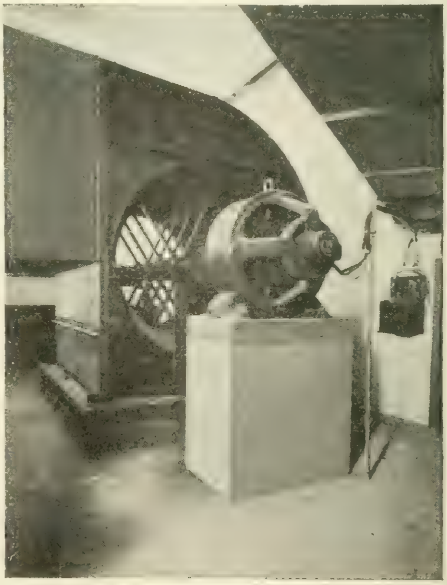


TYPICAL SUPPLY FAN AND SETTING FOR THE SCHENLEY HIGH SCHOOL.

will be made daily, has a one-barrel-capacity dough-mixer, operated by an electric motor. The same motor also operates a cake mixer.

ELECTRICAL APPARATUS.

As in every other detail, the heating and ventilating equipment installed is representative of the best practice. The boilers are served by four stokers furnished with forced draft by a No. 6 Sirocco blower, operated by a commutating-pole, direct-current Westinghouse motor. For ventilating purposes air washers, supply fans, and exhausters are employed. There are nine B. F. Sturtevant supply fans and ten exhausters made by the same company, each of which is driven by a direct-current Westinghouse motor. There are also eight air washers, made by the Carrier Air Conditioning Company, each of which is driven by a 2½ h.p. direct-current Westinghouse motor. The air is drawn from outdoors, purified and moistened by the air washers, brought up to the proper temperature, and sent through the main



ONE OF THE EXHAUST FANS AND SETTING FOR THE SCHENLEY HIGH SCHOOL.

supply fans. The foul air and odors from the kitchens are exhausted by fans located near the roof. A fresh supply of air is possible three times in ten minutes. The temperature is controlled from a two-panel Westinghouse switchboard which operates a thermostatic heat control system.

Forced draft for the forges in the machine shops is furnished by a B. F. Sturtevant Monogram blower, driven by a 10 h.p. direct-current Westinghouse motor.

All motors, blowers and exhausters are mounted on bases composed of 4 in. of wood, 4 in. of cork, and varying degrees of concrete. The motors are direct-connected to the driven apparatus by flexible couplings.

Three-phase, 60-cycle, 2,200 volt alternating current is furnished from the lines of the Duquesne Light Company, and is delivered by a transformer substation maintained by the light company, on the premises, where the voltage is stepped down. Inasmuch as all motors and lights are operated on direct-current at 230 volts, two 300-kw, 6-phase rotary converters, manufactured by the Westinghouse Electric & Mfg. Company, have been installed. These change the alternating-current to direct-current of proper operating voltage. The main switchboard, also furnished by the Westinghouse company, contains two panels, two for the rotary-converter circuits, two for motors, and two for lighting.

Manufactured Gas for House Heating

With Relative Costs of Heat Energy as Supplied by Various Fuels and District Heating Systems.

By GEORGE S. BARROWS and C. C. WINTERSTEIN.

(*From a paper read before the American Gas Institute.*)

Current periodicals and literature on the subject of house heating indicate but little careful study of the use of manufactured gas for house heating and it appears as if it is categorically assumed that it is out of the question. For this trend of opinion we may be to blame for insufficient publicity as is indicated by a recent edition of a handbook on heating and ventilation, published by a well known engineer, in which the author has found it pertinent to add a short chapter on electrical heating and has made therein an approximate computation of the relative costs of electrical and coal heating. No similar comment, however, is to be found regarding the relative costs of gas and coal heating and the thought naturally arises, therefore, as to what the motive could have been which impelled this authority to span the breach between these two widely different methods of house heating while entirely ignoring the fuel, gas. It would seem that the electrical industry, despite obvious obstacles, has been able to demand a hearing in the consideration of this topic while the more logical fuel, gas, and we refer here to manufactured gas in particular, has failed to make a very deep impression.

FACTORS GOVERNING SELECTION OF FUEL.

Summarizing the factors entering into the selection of fuel, using as the base for comparison manufactured gas in those cases where the uses of the fuels are fairly comparable and neglecting fuel cost, we have:

	Anthracite Coal	Bituminous Coal	Coke	Oil	District Heating	Electricity
COST						
Investment	Same	Same	Same	Worse	Better	Worse
Maintenance	Worse	Worse	Worse	Worse	Better	Same
Thermal Efficiency	Worse	Worse	Worse	Same	Better-a	Better-a
Labor	Worse	Worse	Worse	Worse	Better	Better
Insurance	Same	Same	Same	Worse-b	Better-b	Better-b
CONVENIENCE						
Reliability	Worse	Worse	Worse	Worse	Worse	Worse
Ease of handling	Worse	Worse	Worse	Worse	Better	Better
Control	Worse	Worse	Worse	Same	Same	Same
Character of heat	Same-c	Same-c	Same-c	Same-c	Same-c	Same-c
CLEANLINESS						
Fuel before use	Worse	Worse	Worse	Worse	Same	Same
Fuel residue	Worse	Worse	Worse	Same	Better	Better
Control of air	Same-d	Same-d	Same-d	Same-d	Same-d	Same-d

(a)—Except with certain gas appliances.
(b)—In certain cases specified by fire insurance underwriters.
(c and d)—Only in cases where the appliances are such as to make the fuels directly comparable.

from which we see that gas is more desirable than any other heating medium (fuel) except district heating and electricity. (Consideration of fuel costs follows further on.)

"CENTRAL" HEATING.

There are three distinct methods in use to-day for heating buildings from a central heating plant located on the premises, namely:

1. Hot air.
2. Hot-water.
3. Steam.

These methods are at present applicable to any fuel except electricity. Their general principles are so well embedded in the minds of us all that it is unnecessary to relate them here. Our object is to endeavor to show the possibilities of these various systems when operating them with manufactured gas and to draw a comparison of systems so operated using coal as an example. The fundamental working basis in making this comparison is the amount of work to be done and this work is the same whether we are using one fuel or another. It represents the amount of radiation which must be taken care of. Manifestly, this amount of heat is dependent on the construction of the building, the maximum differential temperature between the inside and the outside temperatures, and the required air renewals. It will not differ according to the fuel selected.

Having determined the total amount of heat necessary, one of the first points to present itself for consideration is the efficiency of the heating unit, that is, the percentage of the total heat in the fuel which the heating unit is capable of delivering for utilization. Assuming that the heat lost by radiation from the heating unit and its house connection is usefully employed, the unavailable heat in the coal operated apparatus will be represented by the stack losses (including loss due to incomplete combustion of carbon) and the unburned fuel loss, and in the case of the gas operated apparatus by the stack losses only (no incomplete combustion). The amount of unburned coal dropping through with the ash will depend upon the care of the operator and the efficiency of the grate. In a well designed heater operated with reasonable care this loss will average from 5 to 10%.

DISTINCTION BETWEEN PURPOSES OF STACK.

Regarding the stack or flue loss it will be well to call attention first to the distinction between the purposes of the two stacks when operating with the two fuels. In the case of coal the fundamental object of the stack is to create a sufficient draft (negative pressure as compared to atmospheric pressure) to draw in the necessary air for combustion. In the case of gas the fundamental object of the stack is to carry off the products of combustion to the outside atmosphere and thereby prevent vitiation of the inside atmosphere. In each case the draft must be great enough to overcome the resistances of the various passes and flues to the flow of the products.

The resistance offered to the flow of the products by the spaces between the burners is extremely small compared to the resistance offered by a solid fuel bed and hence the requisite draft for the operation of the gas heater is much lower than that for the coal heater because of this factor alone. In a coal heater probably 30% to 40% of the circulating pressure or potential draft is utilized in overcoming the resistance of the fuel bed.

The remaining factors are all dependent on the velocity of flow. In the gas heater this velocity is less than in the coal heater, since the volume of the products is less, and the resistance losses therefore will be proportionally smaller. This, of course, is based on the assumption that both coal and gas heaters are constructively alike.

Regarding the stack loss, the resistance to flow and consequently the draft necessary to overcome it, would be greater in the case of the gas heater due to decreased stack diameter and higher flue gas density, but these factors are offset by the reduced velocity as already noted. In the accompanying table (Table I) are given two theoretical determinations for coal and gas heaters based on certain assumptions. The starting point in these determinations is the requirement that 200,000 B.T.U. (about 800 sq. ft. steam radiation or 1,330 sq. ft. hot water radiation) are to be supplied hourly. Anthracite coal having a calorific value of 13,770 B.T.U. per pound is selected for the coal installation and carbureted water gas having a calorific value of 600 B.T.U. per cubic foot is selected for the gas installation. The thermal efficiency of the coal heater is taken as 55% and that of the gas heater as 75%. An excess of 160% air is assumed for the combustion of the coal and only 50% for the combustion of the gas. The same radiation loss, 12%, is taken in each case and an unburned fuel loss of 3% is assumed for the coal heater. By difference the flue losses amount to 30% and 13% for the coal and gas heaters respectively. A further assumption in the case of the coal heater is the presence of 0.5% carbon monoxide in the flue gases. This amounts to an hourly loss of 15,400 B.T.U. or 4.2% of the total heating value of the fuel.

The calculated flue temperature amounts to 550° F. in the coal installation and 296° F. in the gas installation, these temperatures producing circulating stack pressures (potential drafts) of 0.31 and 0.215 in. of water respectively. With assumed stack heights of 40 ft., the diameter of the stack for the coal heater is calculated to be 12 in. and that for the gas heater is calculated to be 7 in.

TABLE I—THEORETICAL DETERMINATIONS OF COAL AND GAS CENTRAL HOUSE HEATERS.

Coal	
Kind:	
Anthracite.	
Ultimate Analysis:	
Carbon	85.94
Hydrogen	2.41
Nitrogen	0.88
Oxygen	2.17
Ash	8.08
Volatile Sulphur	0.52
	100.00
Proximate Analysis:	
Moisture	2.25
Volatile matter	8.06
Fixed carbon	81.80
Ash	7.89
	100.00

Gas	
Kind:	
Carbureted water gas.	
Composition:	
Illuminants	10.7
33.6% benzene—3.6	
66.4% ethylene—7.1	
Carbon monoxide	33.4
Hydrogen	38.1
Methane	7.6
Ethane	2.4
Carbon dioxide	3.3
Oxygen	0.7
Nitrogen	3.8
	100.00

	Coal	Gas
Calorific value dry coal, B.T.U.	13,770	
Calorific value (gross) of gas, calculated, B.T.U.		600.3
Assumed volume of air required per pound coal, cubic feet	350	
Theoretical volume of air necessary for complete combustion, cubic feet	134	5.12
Per cent excess	160	50 (assumed)
Calculated volume of air per cubic foot of gas, cubic feet		7.68
Assumed relative humidity of gas, per cent		50
Assumed outside temperature of air, deg. F.	32	32
Assumed relative humidity of outside air, per cent	80	80
Assumed temperature of inside air, deg. F.		50
Assumed relative humidity of inside air, per cent	50	50
Assumed thermal efficiency of coal heater, per cent	55	
Assumed thermal efficiency of gas heater, per cent		75
Assumed radiation loss, per cent	12	12
Assumed flue loss, per cent	30	13
Assumed unburned coal loss, per cent	3	
	100	100
Assumed total hourly heat required, B.T.U.	200,000	200,000
Calculated hourly heat in fuel, B.T.U.	363,636	266,667
Pounds of coal per hour	27.02	
Cubic feet of gas per hour		444.3
Heat lost by radiation per hour, B.T.U.	43,636	32,000
Heat lost in flue per hour, B.T.U.	109,091	34,667
Heat lost in unburned coal, B.T.U.	10,909	
Assumed percentage of CO in flue gases	0.5	
Calculated carbon dioxide, per cent	7.05	11.3
Calculated oxygen, per cent	13.39	7.2
Calculated nitrogen, per cent	79.06	81.5
	100.00	100.00
Hourly heat loss due to presence of CO, B.T.U.	15,399	
Pounds of water formed by combustion of fuel, per hour	5.739	17.912
Pounds of water in combustible as fired per hour	0.608	0.139
Pounds of water in air supplied per hour	2.979	1.064
Total pounds of water in flue products per hour	9.326	19.12
Calculated temperature of flue products, deg. F.	550	296
Hourly volume of products at flue temperature, cubic feet	18,930	5,390
Weight of 1 cubic foot air at 32° F.—0.8 R.H.	0.0803	0.0803
Weight of 1 cubic foot products:		
at 550° F., pounds	0.04	
at 296° F., pounds		0.0524
Circulating stack pressure, number of square feet per foot, pounds	0.0403	0.0279
Assumed stack height, feet	40	40
Circulating stack pressure, inches of water	0.31	0.215
Calculated stack dimensions:		
if square, inches	11x11	7x7
if round, inches diameter	12	7
Dewpoint of products, deg. F.	64	118

The hourly volumes of the flue products, figuring them at the determined flue temperatures, are calculated to be 18,900 cu. ft. and 5,390 cu. ft. respectively, and the total hourly weight of moisture carried off by the products 9 lbs. and 19 lbs. respectively. This moisture weight includes that present in the air and also that present in the unburned gas.

The hourly coal charge amounts to 27 lbs. and the hourly gas consumption to 444 cu. ft. Figuring coal at $7.00 per ton and gas at $1.00 per thousand, the cost with coal is here 8.4c per hour and that with gas 44.4c. This is a ratio of 1 to 5.3. With gas at 80c and 60c per thousand the ratios are 1 to 4.2 and 1 to 3.2 respectively.

REDUCING TEMPERATURE OF FLUE PRODUCTS.

Without considering yet any change in the assumed thermal efficiency of the coal heater, which efficiency represents that obtainable when operating the coal heater under the most favorable conditions, it will be well to see what saving could be effected in the gas installation by a reduction in the temperature of the flue products. We have already seen that a strong draft is not essential for the operation of the gas heater and as the draft is a function of the flue temperature, it will be perfectly safe to reduce this temperature to a relatively low point. Gas heater installations have been successfully operated with stack temperatures of 140°, this reduction having been obtained by the use of an economizer located in the uptake. If, in our problem, the flue temperature were reduced to 140° by the use of the accessory just noted, an hourly saving of 10,599 B.T.U. could be effected, which represents 3.96% of the total energy in the fuel. At 140° we are nearing the dewpoint of the products, which, it will be noted is 118°. If the water or gas entering the economizer is less than 118° some of the moisture may be condensed, the amount so condensed depending on the incoming temperature. Supposing that 50% of the water vapor could be condensed at 140°, then about 9,060 B.T.U. would be transferred to the economizer, the greater part of this heat resulting from the recovery of the internal energy of evaporation. This would represent a saving of about 3.4%.

An economizer could be usefully employed for preheating the return water in a hot water system or preheating the air in a hot air system. It would hardly be warranted in the steam system owing to the relatively high temperature of the returned condensation. It might be economically employed in any of the three systems for heating hot water for general household purposes.

In passing, it may be noted that at 140° and with 50% of the moisture condensed the potential draft would be 0.1 in. of water. The overall thermal efficiency of the installation would become equal to about 82%.

If now, the radiation loss, by the use of good lagging can be reduced to 6%, and the flue loss be maintained at 6% by the use of an economizer, as just noted, the saving effected by the economizer would increase to about 13% and the overall thermal efficiency to 88%.

The 55% thermal efficiency assumed for the coal heater, it must be remembered, is high, and as stated above represents the efficiency obtainable when operating the heater under the most favorable conditions. The average efficiency would be more nearly 40% and as low as 25% when operating the heater at low capacity. With a 40% efficiency the hourly fuel cost of the coal heater in our problem would increase from 8.4c to 11.6c, which, compared to the hourly fuel cost of the gas heater at 85% efficiency, would give the following ratios:

Gas at $1.00	1 to 3.4
Gas at .80	1 to 2.7
Gas at .60	1 to 2.0

With the coal heater operating at one-half the load called for in the problem and at an efficiency of 25%, and the gas heater likewise operating at this load but with an efficiency of 75%, the fuel cost ratios would be as follows:

Gas at $1.00	1 to 2.4
Gas at .80	1 to 1.9
Gas at .60	1 to 1.4
Gas at .50	1 to 1.2

At ¼ load, with the same efficiency for the coal heater, namely, 25%, and a 65% efficiency for the gas heater, our ratios would become:

Gas at $1.00	1 to 2.8
Gas at .80	1 to 2.2
Gas at .60	1 to 1.7
Gas at .50	1 to 1.4

(In concluding their paper, the authors brought out the fact that the National Commercial Gas Association, through its committee on heating, has suggested some experimental types of auxiliary gas house heaters and the authors recommended that these or similar installations be followed up, more tests made with appliances modified as

TABLE II.—RELATIVE COSTS OF HEAT ENERGY AS SUPPLIED BY VARIOUS FUELS AND DISTRICT HEATING SYSTEMS.

In the term "Gas equals 100," the figure 100 is an abstract value selected as a convient base to which the tabulated figures can be compared. Thus, the first tabulated figure "13" indicates that with anthracite coal of 14,000 B.T.U., selling at $7.00 per ton, and burned in a furnace of 100 per cent. thermal efficiency, and with gas of 600 B.T.U., selling at $1.00 per 1,000 cubic feet, and also burned in a furnace of 100 per cent. thermal efficiency, the relative fuel cost of coal to gas will be as 13 is to 100. Again, the last tabulated figure, "421," shows that with electricity selling at 2 cents per K.W.H., and generated in an electrical heater of 1,000 thermal efficiency, and with gas of 600 B.T.U. selling at 50 cents per 1,000 cubic feet, and consumed in a furnace having an efficiency of 60 per cent., the relative cost of electricity to gas will be as 421 is to 100.

Fuel or Heating System.	Calorific Value, B.T.U.	Fuel Cost.	Thermal Efficiency, Per Cent.	Cost of 1,000,000 Useful B.T.U., Cents.	Relative Cost Gas Equals 100 Thermal Efficiency											
					100 Per Cent.				80 Per Cent. Cost Per M.				60 Per Cent			
					$1.00	.80	.60	.50	$1.00	.80	.60	.50	$1.00	.80	.60	.50
Gas mixed, coal and water.	600 per cubic foot	Per M cubic feet. $1.00	100	167												
		.80	100	133												
		.60	100	100												
		.50	100	83												
		1.00	80	208												
		.80	80	167												
		.60	80	125												
		.50	80	104												
		1.00	60	277												
		.80	60	222												
		.60	60	167												
		.50	60	139												
Anthracite coal	14,000 per lb.	$7.00 per ton	100	22.3	13	17	22	27	11	13	18	21	8	10	13	16
			60	37.2	22	28	37	45	18	22	30	36	13	17	22	27
			40	55.7	33	42	56	67	27	33	45	54	20	25	33	40
			25	89.3	53	67	89	107	45	53	71	86	32	40	53	64
Bituminous	14,000 per lb.	$4.50 per ton	100	14.3	8.5	11	14	17	7	8.5	11.5	14	5	6.5	8.5	10
			60	23.8	14	18	24	29	11.5	14	19	23	8.5	11	14	17
			40	35.8	21	27	36	43	17	21	29	34	13	16	21	26
			25	57.4	34	43	57	69	28	34	46	55	21	26	34	41
Coke	14,000 per lb.	$7.50 per ton	100	23.8	14	18	24	29	11.5	14	19	23	8.5	11	14	17
			60	39.8	24	30	40	48	19	24	32	38	14	18	24	29
			40	59.7	36	45	60	72	29	36	48	57	22	27	36	43
			25	95.6	57	72	96	112	46	57	76	92	35	43	57	69
Fuel Oil	17,800 per lb. 117,500 per gallon	$0.06 per gallon	100	51	30.5	38	51	61.5	24.5	30.5	41	49	18.5	23	30.5	37
			80	64	38	48	64	77	31	38	51	61.5	23	29	38	46
			60	85	51	64	85	102	41	51	68	82	31	38	51	61
District Heating—Steam and Hot-Water		20,000 B.t.u. $0.01		50	30	38	50	60	24	30	40	48	18	23	30	36
Electricity	1 Kw. hr. 3,412 B.T.U.	per Kw. hr. $0.10	100	2930	1750	2200	2930	3530	1405	1750	2340	2820	1060	1320	1750	2100
		0.08	100	2340	1400	1760	2340	2820	1120	1400	1870	2250	845	1050	1400	1680
		0.06	100	1760	1050	1320	1760	2120	847	1050	1410	1690	635	794	1050	1270
		0.04	100	1170	701	880	1170	1410	562	701	936	1120	423	527	701	842
		0.02	100	586	350	440	586	706	282	350	468	563	212	264	350	421

experience shows best, and that a committee on house heating design and installation be appointed by the Institute to co-ordinate the work of the members and co-operate with the similar committee of the National Commercial Gas Association for the furtherance of this work.)

Supplementary Report of Heating Engineers' Meeting

Summaries of Papers Mentioned by Title in Last Months' Issue.

Notes on Warm Air Furnace Heating.

By Jesse M. McHenry.

This paper dealt with the moderately-sized gravity furnace system for heating the average home. Mr. McHenry stated that technically-trained heating and ventilating engineers have heretofore withheld approval of this system but he stated that there was a growing interest in this system being shown by engineering colleges. Mr. McHenry endorsed the formula and rules for installation of warm air heating, issued by the National Warm Air Heating and Ventilating Association. He then presented the results of several furnace tests made to determine the efficiency and the causes of heat loss. Efficiencies were obtained running from 64% to 87%. The latter figure was obtained with a 25-in. diameter firepot, burning 5 lbs. of coal per hour. The tests demonstrated, said Mr. McHenry, the wisdom of using furnaces of generous proportions. Under forced circulation, the efficiency was 3% higher in one case, 2% in another and 5% in a third.

In the tests for radiation losses, the losses from the outer casing were found to be negligible, provided the cold air supply is adequate and a reasonably low rate of combustion is maintained. The chimney losses test showed that they may be reduced slightly by doubling the fire travel, with the requirement of only 0.01 in. (water) increased draft pressure.

Some notable results were obtained in tests on the use of extended surfaces to the fire pots. It was found that the frictional resistance due to the presence of the extensions restricted the air velocities, and lowered the efficiency, instead of increasing it. The extensions were set radially, and in the opinion of the author, are of very doubtful value.

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Windows.

By Dr. E. Vernon Hill.

In this paper Dr. Hill reviewed the history of window design and construction and showed that windows were in use in ancient Egypt, at least on the second floors of buildings, but without glass or other protection. That they were also used by the Greeks and Romans is known to be a fact. Instead of glass it was customary to use pieces of colored glass. Dr. Hill then took up modern window construction from the standpoints of first cost, care and upkeep, loss of wall space, admission of flies and other insects, admission of dirt, weakening of walls and injury to building, entrance for burglars, increase of heat loss, interference with mechanical ventilation, increased liability to fire and fire panic and nuisance from noise. Under the last heading he showed that in office buildings in the congested districts of large cities, the noise from electric cars, passing trucks, etc., entirely prevent the use of windows for ventilation on the first, second or even third floors. This is also a serious objection in the cases of hospitals and schools. Dr. Hill spoke at length of the window requirements of factories and workshops, this part of the paper being accompanied by illustrations of typical designs. He stated that pending further development of artificial illumination, natural light for these buildings is to be preferred. He predicted that in the years to come all workrooms, salesrooms and rooms open to the public below the second story above grade would be compelled to be properly ventilated and the air washed and purified.

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IN RECENT years no single item has engaged more attention in heating circles than the advantages of humidified air in connection with the heating of interiors. These advantages have usually been presented from the hygienic standpoint, the argument being made that most of us live in overheated homes and that the supply of additional moisture to the air makes it possible to have equal comfort at a considerably lower temperature. Once in awhile, however, a rash spirit arises to point out the fuel economies to be obtained by this procedure on the ground that the maintenance of a lower indoor temperature, even with a high humidity supply, is a fuel-saving proposition. Many of these enthusiasts point confidently to the coal pile and present carefully-compiled figures showing the savings obtained after humidifying devices were installed.

In connection with such a demonstration in this issue, we present an analysis of the heating and humidity data for a typical condition and the conclusions will, we are sure, coincide with those of most of our readers who have had occasion to take up the matter. They show, briefly, that where there is any considerable range of heating required the evaporation of the necessary amount of moisture to permit a lowering of the air temperature is certainly not a source of economy.

Here we have the cold facts of physics opposed to the confident claims of many whose experiences point in diametrically the opposite direction. How are these experiences to be reconciled with the general laws of physics? Does it mean that in cases where savings are effected, use is being made of a certain portion of the heat that is otherwise wasted? This, in the opinion of many, is the true explanation of the paradox. We should be glad to open our columns to a further discussion of this subject.

◆

ANOTHER phase of the matter brought out in the discussion refers to the advantages of "humidified air" over warm, dry air, which are frankly questioned. Such an argument will appeal to most engineers as a distinctly backward swing of the pendulum, yet plausible points are presented to prove the contention. This in itself might not attract so much attention were it not for the fact that almost identically the same views were expressed by the engineer of a prominent camera concern, in a recent address before a well-known engineering society.

◆

FOLLOWING the custom established some months ago of devoting at least one issue of THE HEATING AND VENTILATING MAGAZINE, during a quarter, to a special subject, we are planning to make the next (April) issue a Central Station Heating Number. The April number will review some of the more important developments in district heating, together with examples of important recent practice in this field.

The Consulting Engineer

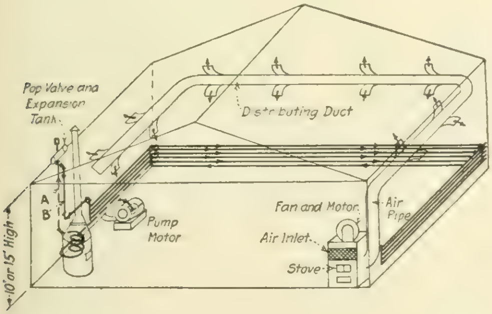
"The Consulting Engineer" is prepared to reply, in this department, to any questions which our readers may ask regarding problems connected with the design and installation of mechanical equipments of buildings.

CONDUCTED BY IRA N. EVANS

72—Methods of Heating Portable Buildings.

QUESTION: Can you suggest a method of heating portable hospital units, such as are used in connection with military camps?

ANSWER: There are several methods that might be employed which are along the line of car-heating devices. One is the Baker hot water car heater, shown in Fig. 1. This has been used successfully for years in heating railroad coaches when they are left on sidings or on branch roads for long periods without connection to the locomotive. A notable example was in connection with the trains on the Brooklyn Bridge, when the cars were operated by cable. The boiler or heater is set on the same level as the coils and the supply pipe is carried through the roof, with a small expansion tank and pop safety valve set at 15 or 20 lbs. The supply pipe is taken from the expansion tank and these two pipes, A and B, give the difference in head to circulate the water. The return is taken to the boiler which is nothing more than a coil of pipe in a stove.



FIGS. 1 AND 3—BAKER HOT WATER CAR HEATING SYSTEM AND PETER SMITH CAR HEATING SYSTEM.

Oil could be burned instead of coal, with burners similar to those used in the Detroit vapor stove. These burn either oil or kerosene. The firepot, when burning oil, should be filled with broken firebrick so that the high-temperature flame from the oil could be properly utilized. In the sketch a coil is shown, but if the weight were a considerable item in transportation, sheet metal radiators could be connected in series with a 2-in. pipe, in the same manner as shown for the pipe coil.

If current were available a small motor pump, of ⅓ or ½ H.P., could be connected in the circuit and used or not, as desired.

This apparatus circulates on rather high temperature, up to 5 or 10 lbs. and a corresponding temperature of 227° to 250° F., so that the heating surface could be comparatively light in weight, especially if sheet-metal radiators were used.

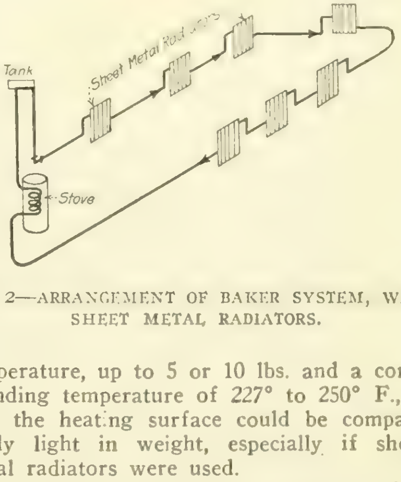


FIG. 2—ARRANGEMENT OF BAKER SYSTEM, WITH SHEET METAL RADIATORS.

Fig. 3 shows a scheme of heating used by the trolley cars in Detroit, made by the Peter Smith Heater Co., which is nothing more than a stove with a small motor and blower on top. The air is blown over the firepot and passed under the seats, recirculating the air of the car. As applied to the case in hand, firebrick could be placed in the firepot and gasolene or kerosene used with a Detroit vapor stove burner. The air-distributing pipes could be collapsible by making them of canvas or sheet metal, with the air distribution overhead.

Of course, this would require electrical current, but with the automobile engine available, a small portable plant could be rigged up to light the whole camp and take less bulk fuel than if torches or lamps were used. Such lighting plants are available in the trade.

The coils would probably be too bulky and weigh too much to transport. The Peter Smith, rig, however, should be very efficient and not of very great weight or bulk. Several of these rigs could be used, as desired.

"Fight for the Straight Red Line."

There is a new slogan in one of the bureaus of the Chicago City Hall. This new battle cry of health is, "Fight for the straight red line." Just what this means will be understood by those who heard Dr. E. Vernon Hill, head of the Chicago ventilation bureau, explain his synthetic air chart at the recent annual meeting of the heating engineers.

It sounds like a queer object of zealous combat, but as explained by Dr. Hill, it is simply a method of putting one's finger, so to speak, on the conflicting factors which make comfortable air conditions. The chart and its use are explained at length by Hermann B. Deutsch, in the Civil Service News.

Formerly if a room became stuffy some one opened a window and let it go at that. Then came the mechanical ventilating system and for a long time it was thought necessary only to supply 30 cu. ft. of fresh air per minute to each person.

The synthetic air chart makes it possible to accurately grade air conditions according to a percentage scale. In connection with its use a series of odor solutions is provided by means of which the relative strength of odors can be determined on some other basis than guesswork. Also a ventilation cabinet is used for testing the effect of various contaminations of air on human beings, and, finally, an instrument is included for counting the number of appreciable dust particles in a given quantity of air.

"Our recent investigations," says Dr. Hill, "have shown that there are a number of factors which determine whether or not the ventilation of a room is what it should be. These factors may be classed under three headings:

"First—Physical conditions, by which we mean the temperature, humidity and motion of the air.

"Second—Contamination conditions, by which we mean the amount of impurities in the way of dust, bacteria or bad odors which the air contains.

"Third—Quantitative conditions, by which we mean the amount of air supplied to each individual, which determines, to a large extent, the amount of oxygen, carbon dioxide, and bodily impurities carried in the air, and the distribution of the air."

USING THE CHART.

According to Dr. Hill, such complaints as "The air in this room is foul," or, "My, but this place is stuffy!" are meaningless. The air may be foul for any one of a number of reasons, and in a great many cases, merely increasing the air supply will not remedy the situation in the slightest.

That is how the synthetic air chart illustrated herewith was developed. In the first division, the three factors considered are (1) temperature, (2) relative humidity, and (3) air motion. These factors are absolutely dependent upon each other. A temperature which is all but intolerable on a moist day, when the humidity is high, is no more than comfortable on a dry day, when the humidity is low. A temperature which "wilts" people when the air is still, becomes pleasantly grateful when the air is in motion. To illustrate: On a hot, "sticky" day, when the air is very still—the sort of day usually described as "close," one is decidedly uncomforable. Yet if on the same day, one is riding in an open automobile, so that the wind of the machine's progress drives off the "closeness," the same conditions of temperature and humidity become almost ideal.

RELATING THE THREE FACTORS.

The problem confronting the army of the "Straight Red Line," then, was one of relating these three factors of temperature, humidity and air motion as closely on a chart, as they were related in actuality. This was accomplished as shown on the first division of the synthetic air chart, where we have horizontal lines, vertical lines and curves. The horizontal lines denote the degree of temperature, the vertical lines the degree of air movement, and the curved lines the degree of relative humidity.

This can be illustrated by choosing at random any temperature—72° F., let us say. A glance at the chart will show that the horizontal line which represents 72° is cut by the relative humidity curve of 40%. The 72°-line is crossed by the 40% curve at a vertical division corresponding to an air movement of about 30 ft. a minute. Translated into terms of ventilation, this means that at 72° F., with a relative humidity of 40%, the air should be moving 30 ft. a minute to insure comfort. Glancing further at the 72°-line, it is cut by the 50% humidity curve at an air velocity of a little over 100 ft. a minute; by the 60% curve at 300 ft. velocity per minute; by the 70% curve at an air velocity of 500 ft. a minute, and by 80% curve at an air velocity of 850 ft.

HOW THE RIGHT DEGREE IS FOUND.

Let us say, then, that a ventilation expert steps into a school room concerning which a complaint has been made. He measures the relative humidity with a sling psychrometer, and finds that the relative humidity is just 50%. He measures the velocity of air movement by placing in front of the ventilation register a manometer and this dial registers 100 ft. per minute. He consults his chart and finds that the 100 ft. per min. line is cut by the 50% humidity curve at the horizontal temperature line of 71°. But the thermometer of the room registers 73°. And there you have one factor that may be causing the whole trouble. The room is exactly 2° too warm. This is indicated on the chart by making a red line two divisions above the base—there is a two-degree penalty for a two-degree improper condition.

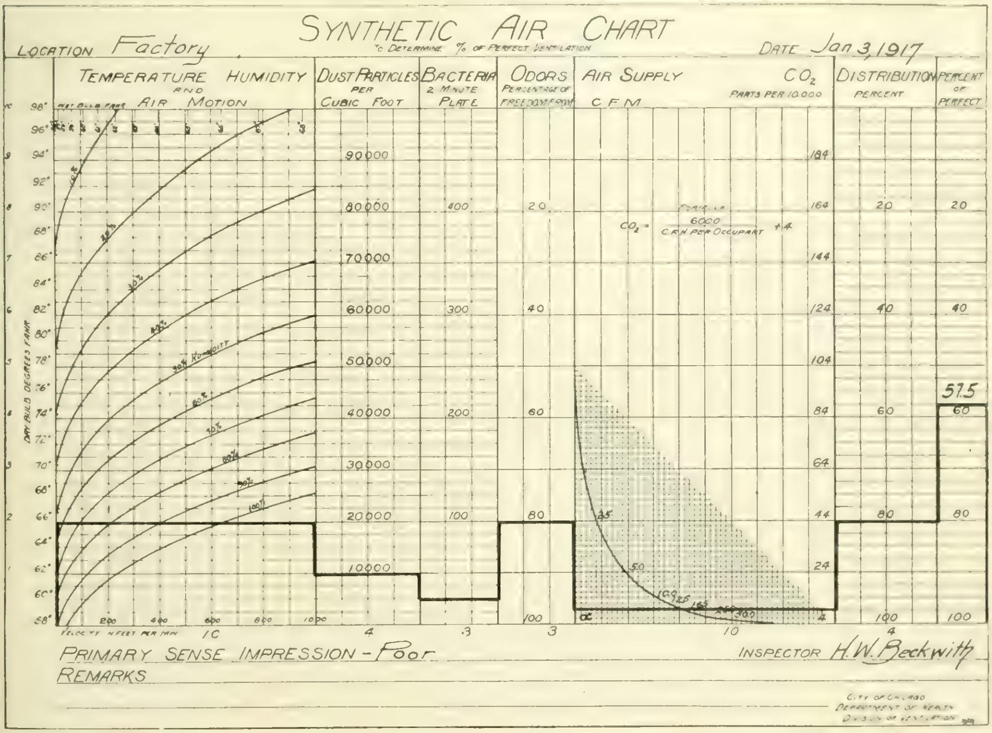


CHART USED IN TESTING INDOOR AIR CONDITIONS.

(Heavy black line running irregularly across chart is printed in red in originals.)

How is it known that these conditions are comfortable? How can the ventilation experts tell that at a certain degree of temperature with a certain per cent of air movement the air should be moving just so fast and no faster? The answer is that it was determined by countless actual experiments. A factory room was donated to the use of the Chicago ventilation bureau for this purpose The room contained several steam jets, by which moisture could be sprayed into the air in any desired quantity or per cent. The room was equipped with special blower fans by means of which the amount and velocity of air motion could be controlled to a nicety. And finally the room was equipped with six large radiators, through which the temperature could be controlled exactly within a wide range.

CONTROL CONDITIONS FOR EXPERIMENTS.

A definite percentage of moisture was sprayed into the air. The radiators were set to a definite temperature. And the "victim" of the experiment was seated in the room and the air motion was gradually raised or decreased by the blowers until the point of greatest comfort was reached. The same experiment was performed with many people under all the different possible combinations of conditions. The air experts know that the points on the chart are the proper points of greatest comfort, because they have been actually tried on a large number of people, and found to be the points of greatest comfort.

NEW TYPE OF DUST COUNTER.

The new dust-counter, invented by Dr. Hill, patents on which are pending at the present writing, is a carefully built air-pump, which draws into itself and discharges exactly 4 cu. in. of air at each full stroke. Each "pumpful" of air is blown against a glass surface which is covered with a sticky mixture of varnish and glycerine. This surface catches and holds exactly 62% of the dust in the 4 cu. in. of air. Then the sticky glass plate, which has previously been ruled in squares to facilitate counting, is placed under a microscope and the dust particles are counted. To calculate from the number of particles on the plate the number of particles in a cubic foot is a simple matter.

DUST SHOWS BAD AIR.

The ideal conditions require absolute freedom from dust; the more dust there is the worse are the air conditions. The bottom line on the chart, as will be seen, represents the ideal condition.

Then there are bacteria. These are counted by exposing a previously sterilized plate of gelatine to the air for two minutes. If this plate is allowed to stand for a few days, the bacteria will multiply so rapidly that on each spot where a single bacterium fell when the plate was exposed, a large number, or "colony" of bacteria will develop. These colonies, being visible to the naked eye, can be counted quite readily. Freedom from all bacteria, or the ideal condition, is again marked on the bottom line of the chart.

The same is true on the chart for the division marked "Odors," which ranges from "Perfect," or 100% through "Faint" and "Decided" to "Strong" and "Very Strong."

BASE LINE INDICATES IDEAL CONDITIONS.

It will be noticed that in every case, and in every division, the ideal condition is represented on the chart along the base line. Since conditions as found are marked on these charts in red ink, the ideal condition would be represented by a "straight red line" along the base, which is what the ventilation experts are fighting for.

In the chart here reproduced the crooked line which deviates so far from the ideal that the average recorded is only 57.5%, is the ventilation record of a factory.

Fuel Economy with Increased Humidity.

A lively discussion has been going the rounds of the daily press over the value, from a fuel economy standpoint, of moistening the air in heated interiors. One of these discussions arose from a statement made by a correspondent of the New York Tribune that there was a great saving of heat in using lower temperatures and humidifying the air. This led to a rejoinder from Professor William Kent who denied the possibility of such saving, asserting that the cost of evaporating the necessary moisture would overbalance any saving due to a reduction in temperature.

He took as an example a room containing 1,800 cu. ft., and having, in exposed wall surface, 80 sq. ft. of brick and 40 sq. ft. of glass. With an indoor temperature of 62° F. and an outside temperature of 32° F., the heat transmitted through the walls would be 2,160 B.T.U. per hour. If it were zero outside, 4,464 B.T.U. additional heat would have to be supplied. To raise the indoor temperature to 72°, under zero conditions, 720 B.T.U. additional would be needed.

As for ventilation, if two changes of air per hour were allowed, this would be equivalent to 3,600 cu. ft. The heat required to raise the indoor temperature from 32° to 62° would be 1,970 B.T.U., and from zero to 62°, 4,071 B.T.U. The additional heat per 10° higher indoor temperature would be 657 B.T.U. The total additional heat required for heating and ventilating at 72° indoors, would be 1,377 B.T.U.

MOISTURE CALCULATIONS.

If the air is at 62° and 60% relative humidity, 3,600 cu. ft. will contain 1.92 lbs. of water vapor. If outside air has been supplied at zero, it will contain only 0.17 lbs., requiring the evaporation of 1.75 lbs. of water to raise the humidity to 60%. If the outside air is at 32°, it will contain 0.71 lbs., leaving 1.21 lbs. to be evaporated.

The amount of heat at 62° required to evaporate 1.75 lbs. of water is 1848 B.T.U., and to evaporate 1.21 lbs., 1,277 B.T.U.

These figures are to be compared with the 1,377 B.T.U. additional heat required to raise the temperature from 62° to 72°. There is a saving of 100 B.T.U. when the outside air is at 32° F., and a loss of 471 B.T.U. when the outside air is at zero.

The conclusions reached by Professor Kent are questioned in a lengthy rejoinder published in the New York Tribune. The writer, Charles E. Manierre, states that instead of taking the mean average winter temperature and humidity of New York

City for the months of October to April, inclusive, which are respectively 44° F. and 73% of saturation. Prof. Kent's figures deal with the exceptional case of a zero temperature, which only happens three or four times in some winters and in other winters not at all, and the freezing point, 32°. which is only occasional, even during the colder of the months during which artificial indoor heat is provided.

"As to these exceptional conditions Prof. Kent has assumed a minimum difference of 10° between moistened and unmoistened air—viz., 62° for the moistened air and 72° for the unmoistened. This difference would be acceptable in milder weather, for the very reason that there would be more moisture in the air drawn from outside and heated to 72°.

"In zero weather the exceeding dryness of the inside air causes many to allow the temperature to range up to a difference of 20° instead of 10°. This difference would more than wipe out the alleged loss of thermal units through moistening the air which Mr. Kent alleges would take place in zero weather.

"Mr. Kent is evidently wrong in another particular. His letter deals with a room containing 1,800 cu. ft. A medium-sized house, 20 x 50 x 60 ft., would have more than thirty times this cubic content. He suggests two complete changes of air each hour and in zero weather the need of evaporating into this air 1¾ lbs. of water every hour. In a day he would have evaporated 42 lbs., which is the equivalent of rather more than 5 gal., and for a medium-sized house, as above, this would be 150 gal.—considerably more than four barrels of water.

"There is no heating apparatus installed in private houses which would accomplish this remarkable result.

"I have been able to keep the air sufficiently humid in zero weather in a house of approximately the size mentioned by evaporating 9 gal. of water, the amount in ordinary weather varying from 2 to 4 gal. As my house is better ventilated than the average, having a very large skylight with adjustable air openings over the central hallway, I am very certain that it is not deficient in ventilation.

"In the matter of ventilation necessary, it seems, at least in a private house, that a family of perhaps six could get along on less than 2,500,000 cu. ft. of fresh air every twenty-four hours, this being the aggregate amount of two changes of air every hour in a house of the size indicated. As sometimes figured 1,000 cu. ft. an hour a person, this amount of fresh air would last two weeks.

"Accepting the figures of Mr. Kent in his illustration of a room of 1,800 cu. ft. and pursuing the inquiry a little further along the same line, but assuming a mean temperature of 44° F., with a relative humidity of 73% for the outside air, the amount of water necessary to be evaporated to make up the deficiency in moisture, instead of being 1.21 lbs. (with the outside air at 32°, or 1.75 lbs. with the outside air at zero), would be but 0.83 lbs., which would use about 880 B.T.U., showing a saving of 497 B.T.U. That is to say, contrasting the 880 B.T.U. with Mr. Kent's figure of 1,377, the saving would amount to about two-fifths as between supplying moisture and increasing the heat. The total units necessary to bring the temperature up from 44° to 62°, added to the figures necessary to moisten it, would show a saving of coal amounting on the average to about one-sixth of that required without moistening the air.

"My statement that a substantial saving could be made is borne out by a pamphlet setting forth the proceedings of the convention of Weather Bureau officials, which was held at Omaha in 1898, and which contained a paper on this subect by William Wilson, which stated that a 'saving of at least 12½% could be made in the total cost of heating.'

"My house is under medium size. My experience has been that prior to 1907 I regularly purchased twelve tons of furnace coal. I then arranged for moisture in the air, and my furnace coal purchases, beginning with 1907, ran as follows: Eight, eight, nine, nine, nine, seven, six, six, eight and seven tons.

"The reduced amount of coal used by me in the later years is partly due to the fact that within the last six years I have used one-half a ton of pea coal for partially banking the fire when the weather became warm, which has resulted in a further saving. This pea coal is included in the above figures, being bought one ton at a time in alternate years.

"In addition to the above I have used in the furnace in different years an aggregate of perhaps four tons of range coal."

Prof. Kent has now favored us with some additional calculations in support of his position and goes further, stating that his own experience is that a comparatively high temperature without humidifying is better for health and comfort than a low temperature with moisture.

"For over 15 years," he states, "I lived in a furnace-heated house in which water was always kept in the furnace pot, and in one of them there was also a pan of water under a floor register. For the last 14 years I have lived in houses heated by hot air, steam and hot water, with no humidification, and I prefer the latter condition. While a man may be equally comfortable at 75° F. and 40% relative humidity and 65° F. with 60% relative humidity, I think the tolerance of changes of temperature is much greater at the higher temperatures. With high humidity a slight lowering of temperature produces chilliness, and a slight raising of the humidity, a sticky feeling."

A TYPICAL PROBLEM.

Take for instance, a problem like the following: 1 lb. of air taken in at 0°, 32° and 52° F., 50% and 100% rel. hum., heated to 62° F. and the water evaporated to make rel. hum. 40% and 60%, or heated to 72° F., without moistening. Required the heat added in each case.

Following are the data:

Specific heat of air 0.248. Latent heat at 62° F., 1,057 B.T.U.

B.T.U. for heating 1 lb. of air from:

	Deg. F. 0	32	52
to 62° F.	15.376	7.44	2.48
to 72° F.	17.856	9.92	4.96

That is, in nearly all cases it requires more heat for heating to 62° F. and humidifying to 40% or 60% relative humidity than it does for heating to 72° F., without humidifying.

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Novel School Ventilation Scheme.

An instance of the use of burlap ventilators for school rooms is reported by W. A. Conrad, superintendent of the Coloma (Mich.) schools. He states that in one building, which is steam heated, and which did not have sufficient ventilation without the use of the open window and its attendant drafts, he took a hint from the burlap ventilators of poultry houses.

We had our janitor get some strip lumber such as is used in making window screens.

POUNDS OF MOISTURE IN 1 LB. OF AIR UNDER DIFFERENT CONDITIONS.

	Relative Humidity, Per Cent			
Temperature, Deg. F.	40	50	60	100
0	0.000358	0.000449	0.000539	0.000898
32	0.001498	0.001872	0.002246	0.003744
42	0.002222	0.002777	0.003332	0.005554
52	0.003246	0.004058	0.004870	0.008116
62	0.004684	0.005855	0.007025	0.011709
72	0.006676	0.008346	0.010115	0.016691

MOISTURE IN AIR AT VARYING TEMPERATURE AND HUMIDITIES.

Temp. Deg. F.	0		32		52		62	
Rel. hum. %	50	100	50	100	50	100	40	60
Moisture, lbs.	0.000449	0.000898	0.001872	0.003744	0.004058	0.008116	0.004684	0.007025

Increase of moisture from	0		32		52	
Relative humidity	50	100	50	100	50	100
to 62° F. Rel. Hum.=40%	0.004235	0.003786	0.002812	0.000940	0.000626	None
Rel. Hum.=60%	0.006576	0.006127	0.005153	0.003281	0.002927	None
multiplied by 1057 to find B.T.U. for evaporation.						
to 62° F. Rel. Hum.=40%	4.476	4.002	2.972	0.994	0.662	—
Rel. Hum.=60%	6.951	6.476	5.448	3.468	3.094	—
Add to these the figures required for heating the air to 62° F.:						
	15.376	15.376	7.44	7.44	2.48	2.48
This gives for heating and evaporation:						
Rel. Hum.=40%	19.852	19.378	10.412	8.434	3.142	2.48
Rel. Hum.=60%	22.327	21.852	12.888	10.908	5.574	2.48
Subtract the figures for heating to 72° F.						
	17.856	17.856	9.92	9.92	4.96	4.96
Gives the increased heat required for heating to 62° F. and humidifying						
Rel. Hum.=40%	1.996	1.522	0.492	(—1.486)	(—1.818)	(—2.48)
Rel. Hum.= 60%	4.471	3.996	2.968	0.988	0.614	(—2.48)

Out of this he made frames to fit the upper half of the school room window and covered them with a light grade of common muslin securely tacked. These were fastened outside the upper sash just as an ordinary wire screen would be.

In the morning, after the rooms are warmed, the upper sash can be lowered and an interchange of air takes place without the detrimental drafts. Neither snow nor rain have caused any difficulty so far.

Last spring we were visited by a Red Cross nurse who was at that time touring the county and investigating the sanitary conditions of the schools. She was profuse in her praise of the fresh, wholesome air condition of the school rooms and of the alert, rosy-cheeked student body resulting therefrom.

LEGAL DECISIONS

Requisites of Claim for Lien.

In proceeding to enforce a mechanic's lien, an intervening claim was made for the heating plant which the intervener had installed in the building. It was objected that the claim did not set forth definitely when the labor and materials were furnished. The claim stated that the clainant entered on the performance of the work on or about December 19, 1911, and did the last work on December 17, 1912. It was held that this was sufficiently definite. But the notice of claim did not state the name of the owner, part owner, and lessee. It was held that therefore it did not support an enforcement of the lien, though the name could be supplied by reference to an attached copy of the contract for installing the heating plant and to the pleadings, since the statutory requirement is that the name appear in the claim.—John F. Noud Co. vs. Stedman, Michigan Supreme Court, 160 N. W., 547.

Infringement of Trade-Names.

To constitute infringement of a trade-mark, a literal copy is not necessary, the test being whether the label or mark is calculated to deceive the public and lead them to suppose they are purchasing an article manufactured by a person other than the one offering it for sale. In a suit to restrain unfair trade competition it appeared that the plaintiffs had been engaged in the manufacture of stoves and ranges for many years and had acquired a large business. The articles were sold in connection with certain trade-names which had been registered as trade-marks and used continuously by the plaintiffs. The defendant manufactured repair parts for the stoves manufactured by the plaintiffs, on which abbreviations of the plaintiffs' trade-names were stamped in the same manner as the plaintiffs stamped them. It was held that the plaintiffs were entitled to enjoin the defendant's use of their trade-names and abbreviations thereof. But there was no question of patent rights involved in the case. The manufacture of the articles without any mark indicating that they were manufactured by the plaintiffs was within the defendant's rights. Therefore a decree restraining the defendant from selling or offering for sale parts for use in stoves manufactured by the plaintiffs without informing that they were not manufactured by the plaintiffs was held to be too broad. Scranton Stove Works vs. C. Clark, Pennsylvania Supreme Court, 99 Atl., 170.

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The Testing of House-Heating Boilers.

A Discussion.

The following discussion was presented, but not read, at the recent annual meeting of The American Society of Mechanical Engineers, following the reading of a paper on "The Testing of House Heating Boilers, by Prof. L. P. Breckenridge and D. B. Prentice. This paper, practically in full, was presented in The Heating and Ventilating Magazine for December, 1916:

Prof. William Kent: The method of rating a house-heating boiler proposed by the authors seems to leave out a most important factor of such a rating, namely the grate surface, or the amount of coal that should be burned per square foot of grate surface.

The authors say, "The capacity or commercial rating of a heating boiler has always been given in terms of the direct radiating surface which it would serve." The capacity of such a boiler thus defined, that is, the amount of radiating surface which it will serve, is an exceedingly variable quantity, depending chiefly upon the amount of coal that is burned under it per hour, which in turn depends on the size of the grate and the rate of combustion. A certain boiler with 1 sq. ft. of grate and say 20 sq. ft. of heating surface may supply 150, 300 or 450 ft. of heating surface, depending on whether the coal is burned at the rate of 4, 8 or 12 lbs. per sq. ft. per hour. It is evident then that no satisfactory rating of a house-heating boiler can be made that does not take into consideration the rate at which the coal is burned. I therefore would amend the authors' definition of a unit for stating the capacity of a heating boiler so as to make it read as follows:

The *foot of radiation* shall be ¼ lb. of steam per hour condensed at 212° F., and discharged as water at 182° (equivalent to 250 B.T.U. per hour) when the coal is burned at the rate of 4 lbs. per sq. ft. of grate surface per hour.

S. B. Flagg and R. L. Beers. The writers have been engaged during the past two years in planning and carrying on an extended series of tests which the Bureau of Mines is conducting for one of the Government departments. The principal purpose of these tests has been to obtain information as to the relative value for domestic heating purposes of a large number of fuels used by this department, including a number of Canadian and foreign coals. At the same time a comparison is being made of steam and hot-water boilers.

In the development of plans for the tests which the Bureau is now conducting the following considerations governed:

The average residence-heating boiler operates during the most of the heating season at a load less than 40% of its rating. Results were desired showing the comparative values of the fuels under average load conditions, and the tests were therefore run at approximately this load.

Conditions of attention were to be comparable to those in actual service so far as possible. For this reason with most fuels charges of relatively large size were fired so as to give a firing period ranging from 6 to 12 hours.

In the case of the steam boiler installed in a residence, neither the rate of delivery of steam nor that at which the condensation returns is uniform. The boiler output was therefore allowed to vary, but the valve controlling the delivery was so set that with automatic damper regulation an average load of approximately 40% of rating was maintained. This corresponds with the authors' requirement.

So far as possible the test data were mechanically recorded and some of the data so recorded by a second piece of equipment.

In order to reduce errors of starting and stopping the duration of the tests was made approximately 48 hours.

Measurement of output can readily be made in either of two ways. One way is to send the steam delivered by the boiler through a closed-type feedwater heater, the condensing water circulating in the coil, and measure the condensate. The other way, which would obviate the use of calorimeter readings in computing results, is to measure the quantity and rise in temperature of the condensing water, the condensate returning to the boiler. Selection of equipment for either method may be made from a wide variety, and nearly any desired degree of accuracy obtained in measuring the output.

Roy E. Lynd. There are two points in this paper which I would like to discuss. The first is that the titles of the paper and of the proposed testing code both confine themselves to house-heating boilers, and the paper states that the class of boilers indicated by the authors under this heading includes only boilers designed to serve 2,000 ft. of radiation or less. It seems that we make a mistake in thus limiting this code. The same boilers which we use in our houses are used very extensively to heat schools, churches, and other large buildings, and several makes of low-pressure cast-iron sectional boilers are designed to serve as much as 10,000 sq. ft. of radiation. We would do well to eliminate the term *house-heating boilers* from the title, the paper and the code, and substitute therefor *low-pressure heating boilers;* and include all low-pressure heating boilers instead of those only which are designed to serve 2,000 ft. of radiation or less. The larger boilers of this class are covered by section (9) of the code, which states that the test conditions should be as nearly as possible like the ordinary operating conditions for the boiler to be tested.

In the A.S.M.E. Boiler Code of 1914, boilers are divided into two classes,—Power Boilers, Section 1, and Boilers used exclusively for Low-Pressure Steam and Hot-Water Heating and Hot-Water Supply, Section 2. This division should be borne in mind in any new testing code. As the proposed testing code is essentially a code for evaporative tests, we are not concerned with boilers for hot-water heating and hot-water supply. It would seem therefore that the new code should cover all boilers used exclusively for low-pressure steam heating, and should be so entitled. The A.S.M.E. Boiler Code, in Section 2, does not limit low-pressure heating boilers to 2,000 ft. or less, and we should not so restrict the testing code.

The second point is in regard to the definition given for a *foot of radiation.* The authors seem to think that the amount of steam condensed per foot of radiation enters more largely into ordinary heating calculations than the B.T.U. They have assumed a convenient average amount of steam per foot of radiation, and have then converted this into an awkward B.T.U. value. This, to my mind, is wrong. We figure practically everything in connection with heating installations in B.T.U., and it is very rare that the question of the amount of steam involved is raised. I would suggest that the *foot of radiation* be defined as a transfer of heat equal to 250 B.T.U. per hour. This figure, and its reciprocal, 0.004, are both very convenient, and would be far preferable to the figures given by the authors.

It has been the writer's practice to test low-pressure boilers at atmospheric pressure, keeping a record of the steam temperature as indicated by a mercury thermometer placed in an oil well directly in the steam chamber in the top of the boiler. The pressures at which these boilers are operated are as a rule so nearly atmospheric, if the heating system is conservatively designed, that a test made at atmospheric pressure comes about as close to actual operating conditions as it can be got. The great advantage of the atmospheric pressure test is, of course, its simplicity, it being unnecessary to use the reducing valve, receiver, and bank of valves spoken of by the authors.

One of the functions performed by this system of pressure control suggested by the authors is in the determination of the time of starting and stopping the test. The test is started by establishing normal running conditions with a pressure of, say, 5 lbs. on the boiler. Then the fire is cleaned and thinned until the pressure drops to say, 3 lbs., when the test is assumed to start. The same conditions are reproduced at the end of the test, the test being over when the pressure drops to the same 3 lbs. This would all be out of the question with a test made at atmospheric pressure. The writer has used for some time a system which is very similar, and which gives practically the same accuracy, and which is applicable to tests made at atmospheric or any higher pressure. Normal running conditions are established before the test, and then the fire is cleaned and thinned just as outlined in the paper, but instead of depending on the pressure dropping to a certain starting pressure, the temperature of the flue gases is used as an index. When the temperature of the flue gases falls to a predetermined point, the test is assumed to be started, and at the close of the test the starting conditions are reproduced until the flue-gas temperature taken at the same point in the flue falls to the starting temperature. This method seems preferable, as the flue-gas temperature is more intimately connected with the condition of the fire than the steam pressure is, and at the same time it enables us to use the very much simpler atmospheric pressure conditions.

It has also been the writer's practice, for some time past, to keep accurate records of the draft in the flue, in the firebox, and in the ashpit, by means of differential draft gages. These data sometimes indicate differences in the draft conditions which may explain differences in test results.

Max Friedlander. Below is a description of a new method for the *continuous* determination of the heat balance of house-heating boilers. The principle of the method was suggested by Prof. H. Junkers, the originator of the Junkers calorimeter, and the method was tried out and applied by the writer in a series of actual tests on a steam-heating boiler in 1911 when he was his assistant at the Technical College of Aix-la-Chapelle, Germany.

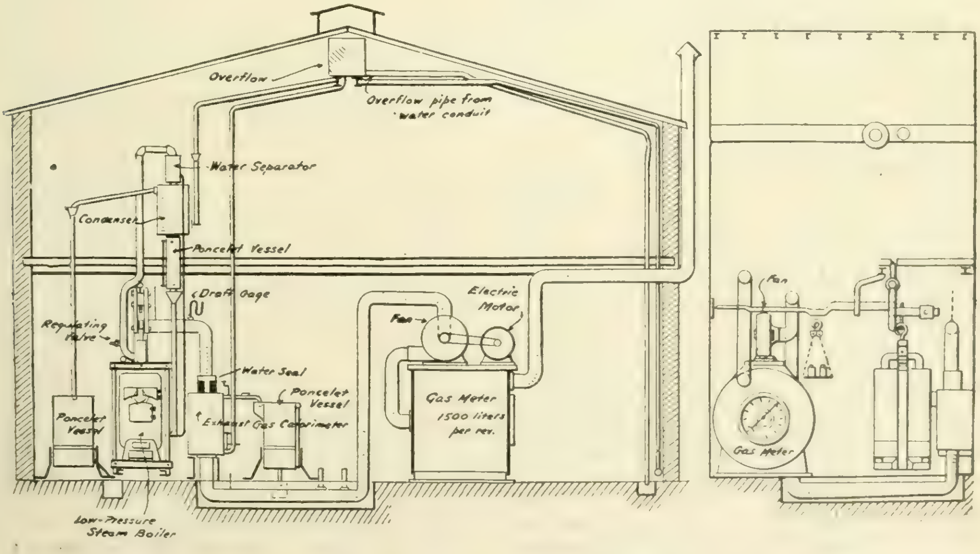


FIG. 1—ARRANGEMENT OF TESTING PLANT FOR HOUSE HEATING BOILERS AT AIX-LA-CHAPELLE, GERMANY.

The idea was to measure all items of a complete heat balance in a continuous way during operation, and for this purpose the boiler was suspended upon a sensitive balance, so the smallest amount of fuel burned off in the boiler could be weighed very exactly at shortest intervals, thus giving a continuous determination of the fuel consumption and the incoming heat. The arrangement is shown in Fig. 1.

The entire steam generated was condensed in a condenser and the condensed water carried back to the boiler. In this way the useful heat could be determined continuously by continuously measuring with a Poncelet vessel the quantity of cooling water used in the condenser and, with the thermometers, the increase in its temperature.

The flue gases were drawn out by a ventilator and carried through a flue-gas calorimeter, in which their entire *sensible heat* was determined by cooling them down to the room temperature by a water jacket, the quantity of cooling water being measured continuously with a Poncelet vessel, and its rise in temperature also being measured. The volume of the flue gases was recorded with a gas meter of 1,500 liters capacity per revolution.

A quite novel feature was the continuous determination of the loss of heat due to incomplete combustion by a new calorimetric method in which the heat value of the flue gases was measured in a calorimeter fitted with a specially designed burner for which a patent is pending. This method for the calorimetry of flue gases has been developed by the writer in separate experiments and tried out in a great number of actual tests and applications on boilers and combustion engines, and it has been described in detail in a dissertation (not yet published), where all these experiments and tests are also reported. The arrangement for this is also shown in the illustration.

The heat loss due to incomplete combustion was very variable and, with the boiler mentioned, wavered between 8% and 23% of the incoming heat when the operation and combustion was normal, and increased to over 45% when the boiler was operated with insufficient excess of air or otherwise in bad condition. In all cases, however, the heat value of the flue gases decreased continuously, or, in other words, the combustion improved steadily in the proportion as the layer of coal was burning off, thus indicating that the boiler was working in the beginning like a gas producer.

Heat radiation and conduction was determined by temperature measurements of the outer surface of the boiler and its surroundings, and by use of individual co-efficients of heat transfer.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

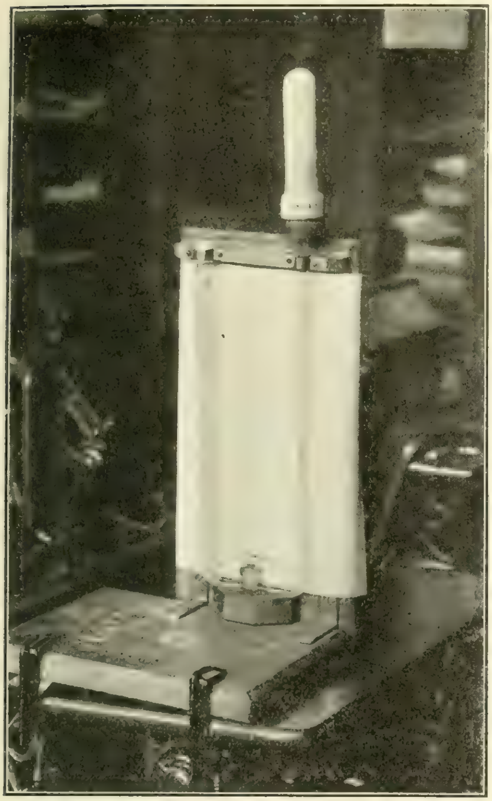
New York Chapter Hears a New Definition of Ventilation.

Members and guests of the New York Chapter who attended the February meeting at the Building Trades Club, February 19, were given a treat in the form of two addresses, one on "Deheating Factors of the Atmosphere and Their Measurement," by George T. Palmer, chief of investigating staff of the New York State Commission on Ventilation; and one on "Physiology of Respiration," by Dr. Milton W. Franklin. Both speakers presented their subjects in a manner that held the close attention of the members for over two hours. The meeting was in charge of a committee headed by J. Irvine Lyle, president of the society.

Mr. Palmer, the first speaker, began by offering a substitute title for his address in the form of "Measurement Without the Use of a Yardstick." After referring generally to the work of the New York State Commission, Mr. Palmer said that there are three principal factors we have to deal with in ventilation work, namely, the thermal factor, the gaseous factor and the floating solids factor. Of these, he said, the thermal factor is the most influential because this affects the body and has to do with the method by which the body loses heat. He described the body as a heat-producing engine whose loss of heat is variable, but whose temperature remains practically the same under all conditions. If a fan blows on a thermometer, he said, the mercury does not fall, yet we feel cooler in a room with a fan running, even though the room temperature may be 68° F.

The thermometer, therefore, does not give all the necessary information. We must know about the evaporative quality of the air. As is well known, the pressure of the moisture in a cloth causes evaporation, and in a study of evaporation it will be found that there is a moisture gradient from the wet bulb thermometer to the surrounding air, or, speaking electrically, there is a difference in potential, the air immediately surrounding the wet bulb being more moist than that a little farther away, and so on. It must also be considered that we do not get the rate of evaporation by use of the sling psychrometer.

Mr. Palmer then described a device that was in use for obtaining the quantity of moisture. This is called an atmometer and includes a porus cup fitted with a U-tube. This instrument, however, applies only to objects at the temperature of the air. It must be remembered that in ventilating work



THE ATMOMETER, FOR MEASURING THE DRYING POWER OF THE ATMOSPHERE.
Principal element consists of finger-shaped porous cup, attached to a glass U-tube.

we are dealing with human bodies at a constant temperature of nearly 99° F.

Mr. Palmer described the katathermometer, designed by Leonard Hill (first described in The Heating and Ventilating Magazine for September, 1915).

A new instrument known as the comfortimeter and designed by Prof. Phelps, was then described by the speaker. This instrument measures the deheating effect of the surrounding atmosphere. In its construction heat is supplied by means of electric resistance coils to a mercury bulb, the bulb becoming heated to above the atmosphere. With the supply of heat constant the bulb is surrounded by a wet cloth and it will then give the amount of heat lost by the air. It is also made up as a recording instrument.

Even with these instruments, said Mr. Palmer, the records obtained do not show what is happening at the feet, but only at the breathing level where they are usually located. The body is something more than a hot object and it is necessary to consider the extremities as well as the main portions.

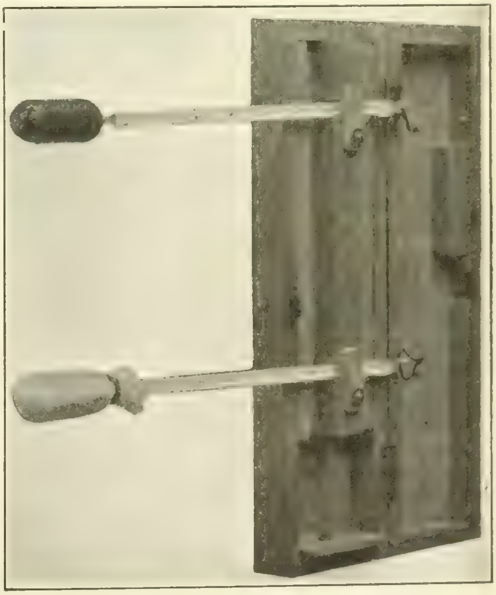
The body, said Mr. Palmer, can also alter its rate of heat loss which adds to the complications.

The speaker gave one plausible reason why outdoor air seems better than indoor air. Out-of-doors, he said, the body meets a fluctuating air movement, but indoors there is usually a steady, unrelenting air movement which affects the body unfavorably. The vaso-motor system may break down under a steady current of air.

Another point that has to be considered when a wet bulb thermometer is used is that the body is not wet or unclothed. Moreover it does not lose all of its heat through the surface but some is lost through the lungs.

In conclusion Mr. Palmer said the engineer must realize all these facts. He is apt to look too much towards achieving mechanical efficiency and not give enough thought to the comfort of the occupants. These two points do not always coincide. The speaker proposed a new definition of ventilation in place of the old one of maintaining a certain standard of air purity. The new definition as proposed is "the adjustment of the air environment to meet the requirements of comfort, health and efficiency."

He added that the work of the commission will probably continue another year before its final recommendations are given out. At that time, however, the commission proposes



THE KATA-THERMOMETER.
For Measuring the Combined Effect of the Three Methods by which Air Extracts Heat from a Hot Object—Radiation, Convection and Evaporation.

to include suggestions for practical applications.

DR. FRANKLIN'S ADDRESS.

Dr. Milton W. Franklin, who followed Mr. Palmer, said that strange as it may seem, the function of the human body is to lose heat. It has been practically disproven that there is anything poisonous in exhaled air and, in fact, there are very few micro-organisms in such air. He also spoke of skin breathing and pointed to the fatal effects that always follow the painting of the entire body, and cited the well-known case of the boy in the Venetian mediaeval fêtes who was covered with gold leaf and placed at the head of the pageant. The fatal effect that always resulted was attributed to unusual virtue and for a long time the real cause was not suspected.

Dr. Franklin gave a very thoughtful discussion of the human anatomy, showing in detail the course of the blood through the arteries to the skin surfaces and back through the veins to the heart, illustrating the part the air plays in serving to keep the blood free from impurities.

In the absence of President Arthur Ritter, the meeting was presided over by Vice-President Frank K. Chew. The report of the nominating committee contained the following nominations: For president, Frank K. Chew; vice-president, C. E. Pearce; treasurer, William J. Olvany; secretary, C. W. Obert; for the board of governors (three to be elected): Conway Kiewitz, George W. Martin, H. G. Issertell, Arthur Ritter, P. H. Seward and A. S. Armagnac.

The report of the entertainment committee which had charge of the entertainment at the annual meeting of the society showed a balance on hand of $178. This will be held by the chapter as a special fund for next year's entertainment.

Ventilation Tests Reported at Meeting of Illinois Chapter.

Ventilation tests made by the Chicago Commission on Ventilation in a modern factory building and in one of Chicago's latest school buildings were reported at the February meeting of the Illinois Chapter, held at the Engineers' Club, Chicago, February 19. F. J. Postel, chairman of the commission, described the tests as made in the Paris Garter Company's factory and in the Lewis-Champlin School, in Englewood. One conclusion reached by Mr. Postel was that modern ventilating systems are basically wrong in that the fresh air supply ducts are almost invariably accumulators of dust. The problem of the future, he said, will be to provide short ducts which can be readily and thoroughly cleaned.

Dr. E. Vernon Hill described his synthetic air chart which is shown on another page of this issue.

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National Warm Air Heating and Ventilating Association Adopts Installation Code.

One of the important actions taken at a special meeting of the National Warm Air Heating and Ventilating Association, held in Cleveland, O., January 24, was the adoption of a code to regulate the installation of warm air furnaces. The various points covered in the code are: meaning of the term warm air heating plant; certified heating contractors; permits; concealing pipes or register boxes; round basement pipes; smoke pipes; stacks and registers; cold air ducts; provision for register boxes and stacks; rules for estimating warm air pipe requirements; and furnace casings. The section containing rules for estimating warm air pipe requirement, has the following to say regarding such requirements for 70° F.:

"In no case shall warm-air pipes, extending from furnace be less than 8 in. in diameter. To find the area of warm-air pipes leading from furnaces through which heat is to be distributed to building or rooms contained therein, requiring the maintenance of a temperature of 70° F., with the outside temperature at zero, the following rules are to be used:

"To the area of outside doors and windows expressed in square feet, multiply the result thus obtained by 75. To the result thus obtained add an amount equal to the total cubical contents of the building or room as expressed in cubic feet; divide the result thus found by 80. The result thus obtained will equal the sectional area of the warm-air pipes expressed in square inches."

The meeting was held at the Hollenden Hotel, with President John D. Green in the chair. The report of Secretary Williams showed that the advertising campaign instituted by the association was bearing important fruit in the form of inquiries from consumers. The association has compiled a list of dealers containing some 18,000 names. This list has not yet been published as there is some difference of opinion as to its advisability, and the expense would also be considerable. Secretary Williams admitted frankly that the association is not making much progress in interesting architects.

The executive committee reported, among

other things, on the uniform contract already mentioned; the pipeless furnace, which, it was stated, should be exploited without extravagant and unwarranted claims; the competitive type of furnace, with a recommendation for its elimination; a uniform guarantee and a resolution against selling furnaces direct to users.

A letter was presented from Professor J. D. Hoffman, of the University of Nebraska, containing the following suggestions for improving furnace heating work:

1. Set furnaces low and have a good pitch to leaders.
2. Insist upon larger wall stacks to upper rooms.
3. Insist upon fully enclosed metal return ducts, and eliminate the duct formed by rough floor joists and wall studding.
4. Urge an ample fresh air connection to the return system in every furnace job.
5. Insist upon vent ducts through warm walls from bath room and kitchen to attic, with no returns.
6. Develop humidifying attachments for furnace.
7. And *most important of all* each manufacturer should have follow-up system on each furnace sold, so as to learn if it has been installed to the satisfaction of the purchaser. This would eventually run out the sham furnace dealer, who thinks only of his income, and nothing of the reputation of the manufactured product he handles.

◆

A Handy Chart for Determining the Weight of Pipe.

Since there is so little difference in the weight of wrought-iron and mild steel pipe, the chart shown herewith may be used for either. It is based on 0.283 lbs. per cubic inch, or 490 lbs. per cubic foot. The chart must not be used for calculating cast-iron pipe, however, without remembering that the final result must be multiplied by 0.92. That is, a cast-iron pipe weighs only 92% as much as a wrought-iron or mild steel pipe of the same dimensions.

For example, what is the weight of a wrought-iron pipe line 100 ft. long, 5 in. internal diameter and ⅛ in. thick.

Run a straight line from the 100 (column A) to the sum of the diameter and thickness, 5.125 in. (column E) and locate the intersection with column B. From that point of intersection now run over to the thickness 0.125 in. (column D) and the answer is found to be 700 lbs. in column C. If the pipe were cast-iron, the weight would be 700 x 0.92 = 644 lbs.

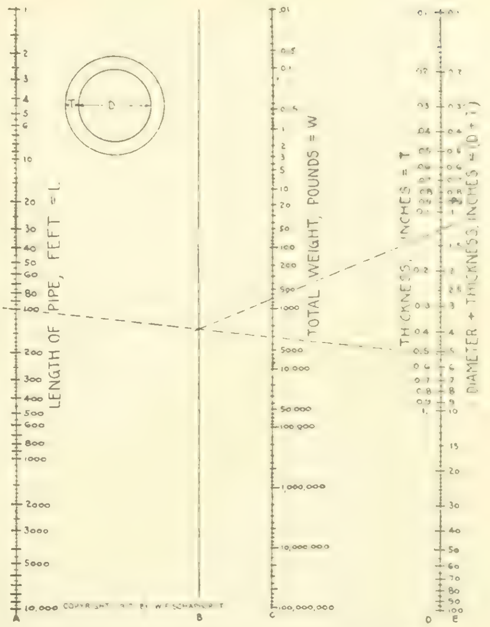

CHART FOR FIGURING WEIGHT OF PIPE.

The range of the chart, it will be noted, is great enough to care for any ordinary problem and for most extraordinary problems. It will handle lengths of pipe up to 10,000 ft. and diameters up to 100 in. Where thicknesses are greater than 1 in., the user will have no difficulty in learning how to extend the capacity of the chart to a thickness of 10 in. Thus, a wrought-iron pipe 10,000 ft. long by 100 in. inside diameter by 10 in. thick would weigh very close to 100,000,000 lbs.—*W. F. Schaphorst.*

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Twenty Miles of Byers' Pipe Used in William Penn Hotel.

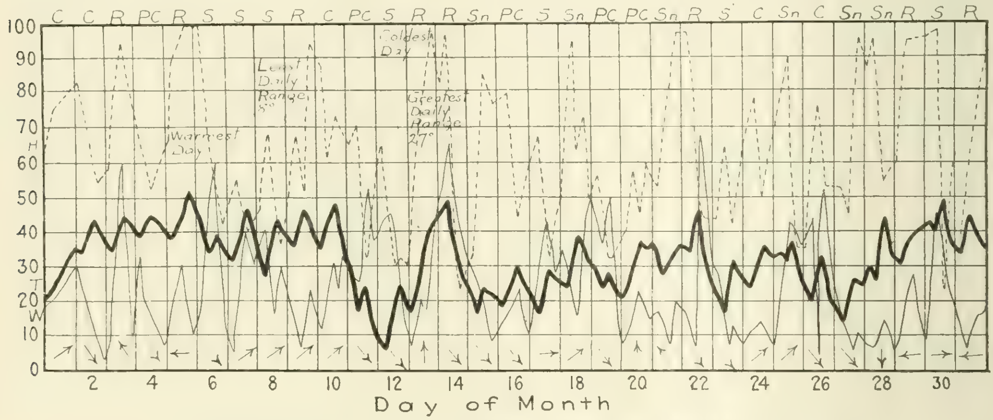
In the account, published last month, of the general mechanical equipment of the William Penn Hotel, Pittsburgh, Pa., the important fact was omitted that approximately 20 miles of Byers' wrought-iron pipe and nipples, made by the A. M. Byers Co., Pittsburgh, were used in this installation. This hotel was designed and constructed by Pittsburgh interests, attesting to the reputation of Byers pipe in the Steel City.

◆

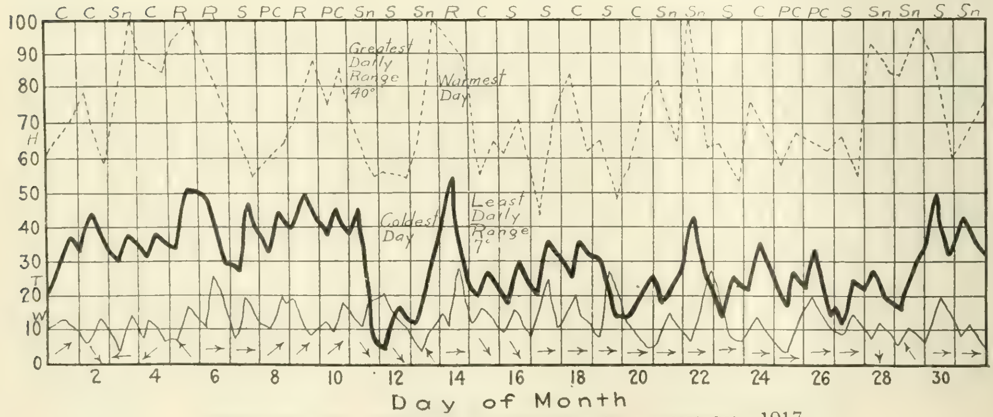
E. W. Pennrich has been appointed advertising manager for the Bishop-Babcock-Becker Co., Cleveland, O., manufacturers of the Reliable line of vacuum and vacuvapor heating equipment. Mr. Pennrich will have entire charge of the company's vacuum heating advertising as well as of its other lines.

The Weather for January, 1917

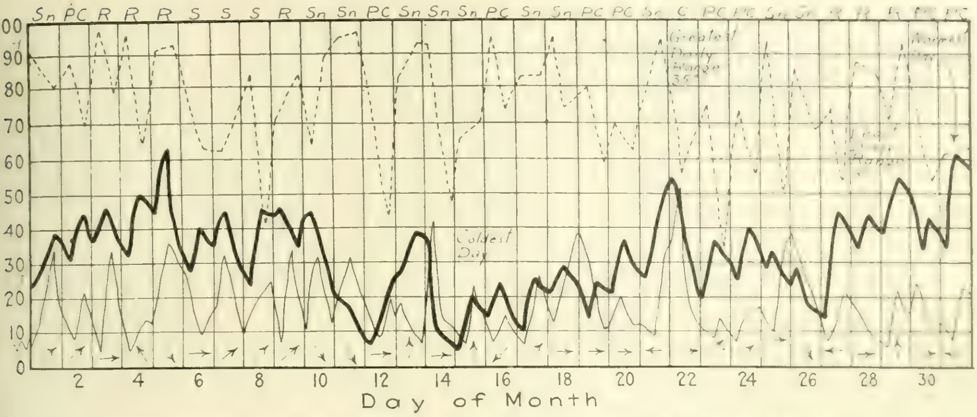
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	52	55	62	47	65
Date of highest temperature	5	14	31	29	21
Lowest temperature, degrees F.	7	5	5	—4	11
Date of lowest temperature	12	12	15	14	14
Greatest daily range, degrees F.	27	40	35	27	50
Date of greatest daily range	13	11	22	10	31
Least daily range, degrees F.	8	7	8	6	7
Date of least daily range	8	15	28	20	15
Mean temperature for month, degrees F.	32.4	30	32	24.2	34.8
Normal mean temp. for month, deg. F.	30.2	27	30.7	23.7	31.0
Total rainfall, in.	2.44	2.82	4.33	1.55	1.72
Total snowfall, in.	5.9	13.6	8.7	9.9	2.5
Normal precipitation, this month, in.	3.79	3.82	2.87	2.0.	2.27
Total wind movement, miles	14389	8320	9340	10483	10778
Prevailing direction of wind	N.W.	W.	S.W.	S.W.	N.W.
Average hourly wind velocity, miles	19.3	11.2	12.6	14.1	14.5
Number of clear days	7	9	3	18	9
Number of partly cloudy days	8	5	13	5	13
Number of cloudy days	16	17	15	8	9
Number of days on which rain fell	14	12	18	7	8
Number of days on which snow fell	6	8	11	4	1
Snow on ground at end of month, in.	None	0.6	None	Trace	None



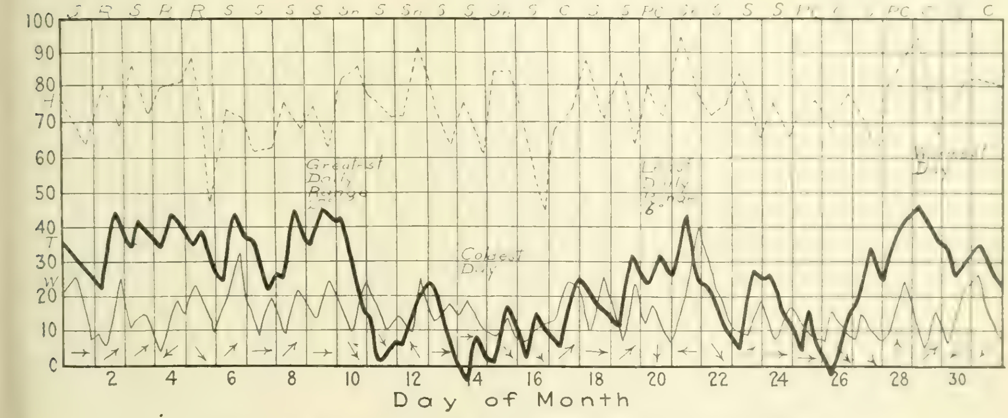
RECORD OF THE WEATHER IN NEW YORK FOR JANUARY, 1917.
(Hourly Observations of the Relative Humidity Are Recorded on this Chart.)



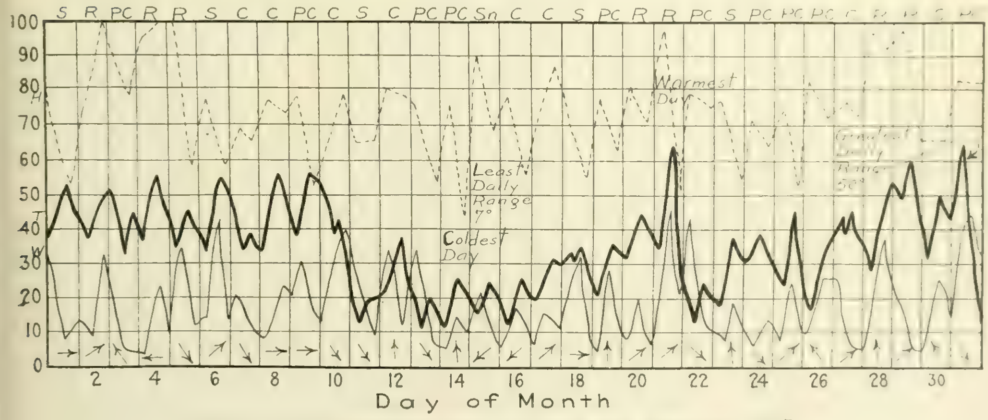
RECORD OF THE WEATHER IN BOSTON FOR JANUARY, 1917.



RECORD OF THE WEATHER IN PITTSBURGH FOR JANUARY, 1917.



RECORD OF THE WEATHER IN CHICAGO FOR JANUARY, 1917.



RECORD OF THE WEATHER IN ST. LOUIS FOR JANUARY, 1917.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

CORRESPONDENCE

Handling Cotton Lint.

Editor Heating and Ventilating Magazine:

The writer is at present engaged in the design of a collecting system for collecting and disposing of a finely-cut up cotton lint, produced in the operation of knitting machinery. The principal difficulty so far met is the collecting of same, rather than the receiving of it after it leaves the suction fan. The system consists of a number of 2-in. ducts feeding into a tapered duct from 3 in. to 7 in. in diameter, from two directions and continued with one 10-in. tubular duct to a Buffalo No. 5 fan in basement, a distance of approximately 20 ft. A Spray Engineering Company's No. 2 nozzle is inserted in the discharge end of the fan, but it does not seem to properly moisten the lint, as expected. Can you recommend a particular nozzle that would do so? Also, what kind of an exhaust chamber would be necessary, so that the by-product could be gathered and packed at a low cost?

Milwaukee, Wis. P.

A spray nozzle at the discharge of the fan is hardly of any practical value, owing to the high velocity at which the air and products are discharged. There is no time for the spray nozzle to moisten them.

For an exhaust chamber, there is probably nothing better than a heavy burlap bag into which this material could be blown. The ordinary cyclone collector is not suitable for this purpose. It would have to be built very large and the air would have to escape at a very low velocity to prevent the material from being carried out.

Standard Heating Data Tables.

Editor Heating and Ventilating Magazine:

In looking over the "Standard Data Sheets," published in your last issue, I note what seems to be an error in the matter of the losses through the combined brick and sandstone walls for the 12-in. brick sections. You will note that the losses for this column are less than for the 16-in. brick. I also note that the losses through a brick wall, plastered on each side, are greater than for an unplastered brick wall of the same thickness. Is this correct?

Boston, Mass. C.

Editor Heating and Ventilating Magazine:

We have the February number of The Heating and Ventilating Magazine and have looked over the heat loss tables shown on Pages 59, 61, 63 and 65. We can hardly understand how or why the heat loss co-efficient is greater on a brick wall, plastered inside, than it is on a plain brick wall, while the co-efficient for a brick wall, plastered on two sides, is lower.

Wilkes-Barre, Pa. T.

Our correspondents are correct regarding the inconsistency of the heat loss factors given. In covering such a complete line of wall construction, it was, of course, necessary to adopt values as developed by several different authorities. For instance, the co-efficients for the plain brick wall and for the same wall plastered were taken from one set of authorities, including Carpenter, the German government, the Austrian government, Recknagel, Reitschel and others. When it came to the question of a brick wall plastered on both sides and for certain smaller thicknesses of brick wall, it was necessary to go to some other authority. In regard to walls plastered on both sides, it was necessary to consult still another authority. Therefore, the differences mentioned by our correspondents come from accepting certain authorities upon the constructions with which they have experimented and then accepting other authorities for other constructions upon which the first have not experimented. The brick and sandstone co-efficients are explainable in the same way.

Suggestions are asked from our readers as to what they would recommend for changes in the tentative tables presented. Outside of making the tables "look right," there does not seem to be any reliable basis upon which to suggest changes.

National Safety Council Issues "Safe Practices" Leaflets.

The National Safety Council, a prominent accident prevention agency, has a committee of 50 safety experts working out the maximum and minimum requirements in safeguarding. The findings of these experts are being summed up in the council's monthly "Safe Practices" leaflets. Those already issued cover "Ladders," "Stairs and Stairways" and "Boiler Rooms."

The "Boiler Room" leaflet is a publication of eight pages which starts out with the statement: "The first law in the boiler room is order. The second is care. The third is proper space." Special attention is given to to lighting, elevated runways, floors, storage of fuel, water supply, hot wells, from water supply to boilers, and safety equipment. This is followed by a section on "Operating Rules for Boilers," the leaflet concluding with suggestions for team work and a concise list of "Safe Practices." Details as to this and other phases of the National Safety Council's activities will be supplied to anyone interested by addressing W. H. Cameron, general manager, 208 South La Salle Street, Chicago, Ill.

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A. Everly Carpenter, II, Honored at Dinner.

A farewell dinner in honor of A. Everly Carpenter, II, New York manager of the heating department of E. F. Houghton & Co., Philadelphia, in anticipation of his departure for Paris to assume the duties of foreign manager of the company, was given at the Hotel Astor, New York, January 29. The host was the M. K. Bowman-Edson Co., of New York, which represents the other lines of E. F. Houghton & Co., in New York.

Covers were laid for 75 guests. Charles E. Scott, now general manager of the Vapor Heating Company, acted as toastmaster, and the principal address was made by Charles E. Carpenter, president of E. F. Houghton & Co., whose subject was "Philadelphia Scrapple." He spoke principally of the need of preparation for the economic struggle that will follow the close of the European war and stated that one of the reasons for sending his son back to Paris, where he was formerly stationed, was to keep in touch with the industrial situation abroad, with the possibility, he intimated, of the company's establishing a manufacturing plant for its products in France.

Other speakers were the guest of the evening and M. K. Bowman, M. W. Franklin, Frank K. Chew, H. G. Issertell, and John E. Miller, who succeeds Mr. Carpenter as New York manager for the Houghton company's heating line.

◆

Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the aricle mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

FANS

Characteristics of Fan Blades. O. S. Jennings. Ills. 3500 w. Elec. Jl—Dec., 1916. Fans of the propeller or disc type. 20c.

RESIDENCES

Heating and Ventilating Dwelling Houses. C. T. Alfred Hanssen. Read before Soc. of Engrs. 3000 w. Surv'r—Nov. 17, 1916. Heat insulation of importance. 40c.

VENTILATION

Betrachtungen über Mechanische Lüftung. K. Meier. Ills. 3000 w. Schweiz Ban—Nov. 11, 1916. Mechanical ventilation as applied to schools and other public buildings in the United States and Europe. 60c.

◆

Death of Henry Gordon Stott.

Henry Gordon Stott, superintendent of motive power of the Interborough Rapid Transit Co., New York and the New York Railways Co., of New York, died at his home in New Rochelle, N. Y., January 15. He had been ill several months. Mr. Stott was one of the most prominent figures in the field of engineering in this country.

DINNER TO A. EVERLY CARPENTER, II, HOTEL ASTOR, NEW YORK, JANUARY 29, 1917.

Organization of the Braemer Air Conditioning Corporation.

As announced in the January issue, the Braemer Air Conditioning Corporation has been organized to take over the air conditioning department of Warren Webster & Co., Camden, N. J. This includes the good-will, patent rights, engineering data, records and patterns, for the manufacture and sale of Webster air conditioning apparatus for air washing, dust removal, humidifying, dehumidifying, reclamation of materials, cooling and drying; and the Braemer system of humidity and temperature control.

WILLIAM G. R. BRAEMER,
President.

The highly specialized and distinct engineering problems involved in the application of this apparatus have long indicated the advisability of an independent organization for more aggressive expansion and for better attention to the customer's requirements.

It will be the policy of the new corporation to maintain the present engineering standards and high quality of material and workmanship and to extend to patrons the same attention and co-operation as they received formerly. To prospective purchasers the new company offers the advice of men trained in all branches of air conditioning. Ample capital, it is announced, will enable the company to handle large or difficult undertakings.

William G. R. Braemer, president of the corporation, is the inventor of and has secured numerous patents on Webster air washers. For the past nine years he has had entire charge of the Webster company's air conditioning department. He was previously chief engineer of the Buffalo Forge Company. A graduate of the college of Technology, Copenhagen. Mr. Braemer has made air conditioning a life study.

The treasurer of the corporation is Herbert Coward. He was graduated from Cornell University as a mechanical engineer in 1901 and has been actively identified with the heating, ventilating and air conditioning field for the past 16 years. He was for several years manager of the Philadelphia office of the Buffalo Forge Company and recently gave up his position in another air conditioning firm to become associated with the Braemer corporation.

H. A. Tyrrell, secretary of the corporation, is a graduate of the Massachusetts Institute of Technology and has been Mr. Braemer's assistant with Warren Webster & Company.

The corporation maintains an efficient engineering staff among the members of which is E. Nesdahl, a mechanical engineering graduate of the University of North Dakota.

The management of western territory will be in the hands of L. D. Emmert, 1401 Marquette Bldg., Chicago.

Other representatives appointed to date are as follows:

H. A. TERRELL,
Secretary.

H. COWARD,
Treasurer.

Cincinnati, W. C. Green, 310 Provident Bank Building; St. Louis, Hester & Bradley, 1212 Chemical Building; Kansas City, B. Natkin, 304 Finance Building; Indianapolis, Weinshank & Fenstermaker, 821 Hume Mansur Building; Cleveland, T. G. Phegley, 705 Rose Building. Representation is also being arranged in other large cities.

◆

New Books.

The Modern Factory, treating of factory conditions as they are and as they should be, is the title of an important work by George M. Price, M.D., formerly director of investigation for the New York State Factory Commission and now director of the joint board of sanitary control in the cloak, suit and skirt, and the dress and waist industries, New York City. Dr. Pierce has had unusual opportunities to learn at first hand the conditions and requirements for safety, sanitation, efficiency and welfare work in factories and his comprehensive survey of industrial conditions takes in the entire country, together with numerous examples and suggestions gleaned from a trip abroad. An entire chapter is devoted to "Air and Ventilation in Factories," which was edited by Prof. C. E. A. Winslow. Another chapter deals with "Industrial Dusts and Dusty Trades," while a third is given over to "Industrial Poisons, Gases and Fumes." The book is one of special interest to owners, supervisors, hygienists and lawmakers. Cloth, 6 x 9 in. xiv—574 pages, 257 illustrations. $4.00 net. Published by John Wiley & Sons, 432 Fouth Avenue, New York, or may be had through the book department of THE HEATING AND VENTILATING MAGAZINE.

HOW TO MAKE THE BUSINESS PAY, with special reference to the sheet metal business, is the title of a new book by Edwin L. Seabrook, secretary of the National Association of Sheet Metal Contractors of the United States. The book is also intended to apply to the business of heating, plumbing, electrical and building contractors. It contains methods for ascertaining the cost of conducting business, estimating on contracts, bookkeeping, conducting collections and credits, publicity and business correspondence, and securing and retaining customers. The author's long personal business experience in the sheet metal trade is drawn on at length for his criticisms and advice. Size 6 x 9 in. Pp. 173. Price $2.00. Published by Sheet Metal Publication Co., New York, and may be had through the book department of THE HEATING AND VENTILATING MAGAZINE.

◆

New Publications.

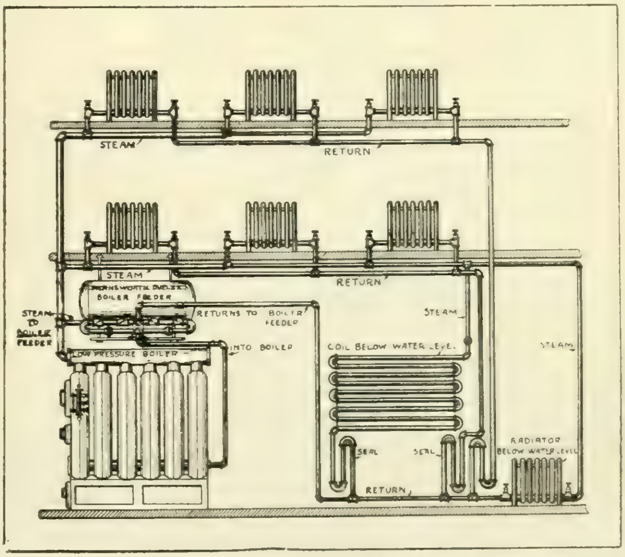
BULLETIN OF THE NATIONAL DISTRICT HEATING ASSOCIATION for January, 1917, contains, among other things, another installment of the history of the association, written by Secretary D. L. Gaskill. The DeWolf and Bushnell administrations are covered in this installment. There is a letter from President Byron T. Gifford regarding the forthcoming convention in Detroit, next June, and there are some proposed changes in the constitution which will be taken up at that time. An interesting description of the high pressure steam line under construction by the Merchants' Heat & Light Co., of Indianapolis, is contributed by G. W. Hubley, general manager and chief engineer of this company.

◆

Use of Farnsworth Duplex Boiler Feeder for Draining Condensation from Apparatus Below Water Line.

The accompanying illustration shows a typical two-pipe low pressure heating system, to which is connected the Farnsworth duplex boiler feeder for draining condensation from radiators or apparatus below the water line of the boiler.

It will be noted that all radiators or coils having return lines that are above the water line of the boiler have a seal at the entrance of the main return line. These seals retard or eliminate possible short circuits between the radiators above the water line of the boiler, and give more free circulation to the radiators or coils below the water line. It is to be noted that the coil shown herewith is half way above the water line and half way below it; therefore, a seal is used on this return connection. As 1 lb. of steam pressure will force water upward about 30 in., it is necessary to maintain a pressure on the boiler of at least 1 lb. for every 30 in. that the boiler feeder is above the lowest radiator. Figuring safely on this covering friction of elbows, pipe, etc., allow 1 lb. pressure for every 2 ft. that the lowest radiator is below the boiler feeder.



ARRANGEMENT OF FARNSWORTH DUPLEX FEEDER FOR DRAINING CONDENSATION FROM BELOW WATER LINE OF BOILER IN A TWO-PIPE SYSTEM.

This duplex boiler feeder has two chambers. One chamber is always open receiving the condensation from the radiators, while the other chamber is under pressure, feeding the water into the boiler. The alternate filling and emptying of these chambers tilts the tank back and forth, which operates the control valves.

The boiler feeder does not need to set directly over the top of the boiler, but can be set any place that is convenient; but it must be set at least 2 ft. above the water line of the boiler. The apparatus which is made by the Farnsworth Mfg. Co., Boston, Mass., is positive in its operation and is packless, with the trunnion stuffing boxes eliminated. There are no machined parts in connection with it; floats, levers, weights and all adjustments are eliminated. The apparatus is noiseless, being provided with rubber bumpers.

NEW DEVICES

A New Line of Automatic Temperature Controllers.

In the field of temperature measurement, as applied to industrial works and manufacturing plants, the logical steps are:

(1) To measure and indicate the temperature with a reading instrument; (2) to automatically record the temperature with a graphic recording instrument; and (3) to automatically control the temperature.

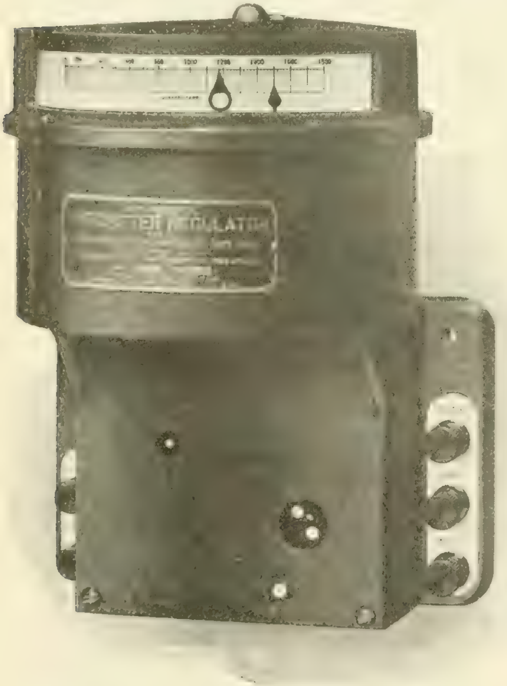


FIG. 1—MEASURING AND CONTROLLING ELEMENTS OF BRISTOL TEMPERATURE CONTROLLER (THERMO-ELECTRIC TYPE).

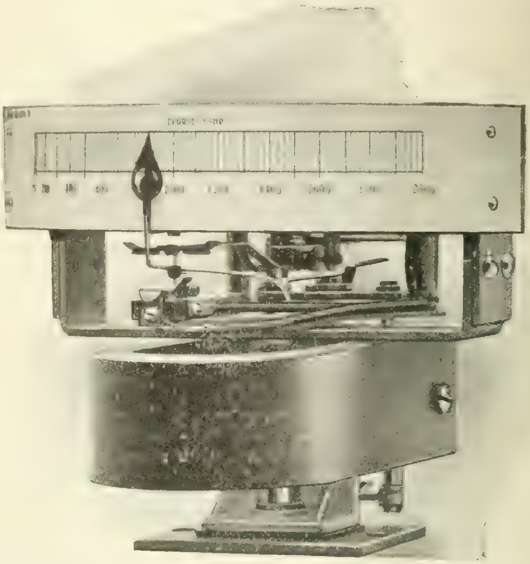


FIG. 2—INTERIOR VIEW OF CONTROLLING ELEMENT, BRISTOL TEMPERATURE CONTROLLER.

At the present time manufacturers are trying to use automatic apparatus wherever possible, thereby eliminating the personal element and there is a demand for automatic temperature controllers in many processes. This situation lends special interest to the comprehensive new line of automatic temperature controllers for gas- and oil-fired and electrically-heated furnaces, brought out by the Bristol Co., Waterbury, Conn.

The principle of operation of these controllers is the use of three elements, measuring, contacting and operating. The measuring element consists of a number of different types of Bristol's electric pyrometers and thermometers. The controlling element is combined with the measuring element and consists primarily of a patented electrical-contact closing device which operates at predetermined high and low temperatures, and closes or opens electrical circuits, thus energizing or disconnecting the operating element. The operating element consists of the device which actually regulates the heat supply in the furnace, as, for instance, in the case of a gas-fired furnace, a pair of electrically-operated gas and air valves.

These controllers can be furnished for all temperatures up to 3000° F.

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Trade Literature.

Alberger Multi-Head Water Heaters are described in a new bulletin (No. 205) just

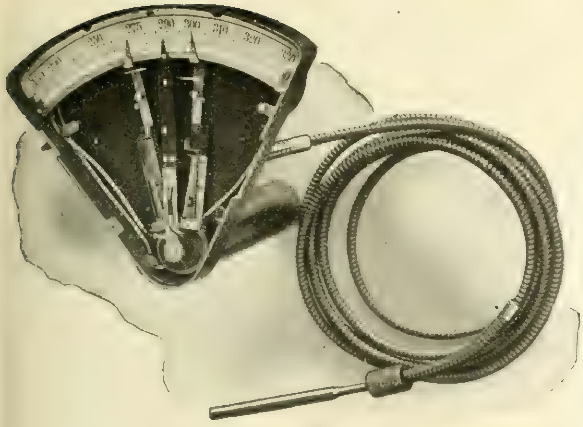
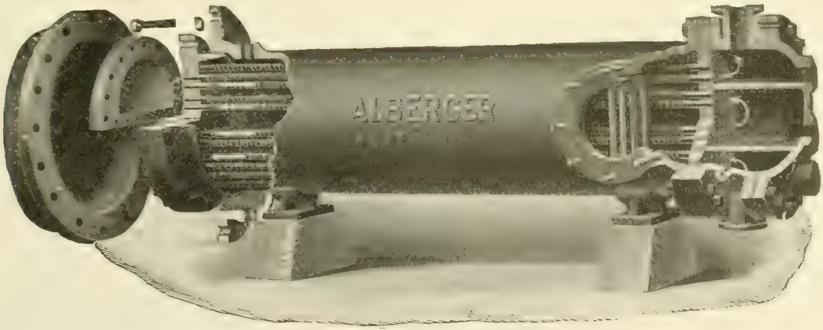


FIG. 3—INTERIOR OF A BRISTOL THERMOMETER-THERMOSTAT.

issued by the Alberger Heater Co., Buffalo, N. Y. This heater is designed to supply hot water to hotels, laundries, office buildings, apartment houses, hospitals, factories and similar buildings. The shell, tube heads, water channel and the steam and water heads are made of a special grade of cast-iron. The heating surface is composed of seamless drawn copper tubes, the efficiency of which is further increased by helical corrugations, which give the water a swirling motion, increasing the rate of heat transmission as well as keeping the tubes free from scale. All water and steam connections are on the body of the shell, so that it is not necessary to break these connections to secure access to the heating surface. This heater has been designed to take care of expansion and contraction. Through the use of the multi-heads each group of tubes is allowed to expand and contract independently. It is a fact that those tubes containing the hot water expand appreciably more than tubes containing cold water. This unequal expansion would cause very serious strains, and oftentimes fractures in the tubes or shells of heaters, unless such expansion strains were properly relieved The heaters are built for capacities from 200 to 200,000 gal. per hour, in either horizontal or vertical pattern.



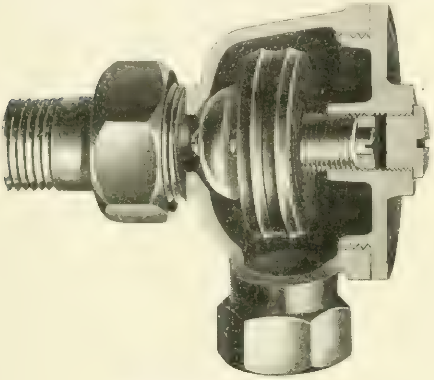
CONSTRUCTION FEATURES OF ALBERGER MULTI-HEAD WATER HEATER.

NATIONAL NOVUS BOILERS, manufactured by the National Radiator Co., Johnstown, Pa., featuring the three-piece firepot, are illustrated and described in a new catalogue. This boiler is described as especially adapted for small buildings and residences. It is of rectangular shape, the claim being made that this gives 10% additional heat surface. The corners are slightly rounded to prevent "dead corners." The three-piece firepot feature makes the heater a "one-man boiler" in that it is comparatively easy to handle and erect. More uniform castings, it is stated, can also be obtained in a firepot of three parts. Another unusual feature is the location of the draft door at the left side of the base, high enough to allow the ashes to accumulate without obstructing the air inlet. The catalogue contains complete list prices, ratings, and measurements. Size 6 x 9 in. Pp. 23.

IMICO HOUSE HEATING BOILERS, for steam and hot water, and specialties manufactured by the Illinois Malleable Iron Co., Chicago, Ill., are featured in a recent catalogue devoted to this company's extensive line. The Imico house heating boilers are adapted for burning anthracite coal, bituminous coal, coke or wood. The down-draft series is made for both steam and hot water and ranges from 2,600 sq. ft. for steam to 7,600 sq. ft. radiation for water. In addition to this and the regular line of sectional boilers, the catalogue has a section on the Imico vapor vacuum heating system which includes the Dewey air valve, Dewey vacuum valve, Dewey tri-duty air and vacuum trap and Dewey duplex tri-duty air and vacuum trap. Size 6 x 9 in. Pp. 32.

73% TO 81% VS. 60% EFFICIENCY is the title of a recent folder issued by the Kewanee Boiler Co., Kewanee, Ill., giving data and results of five tests of various Kewanee fire-box boilers made by Lewis M. Ellison, consulting engineer. The ordinary type of boiler, states the folder, seldom averages more than 60% efficiency. These tests showed that with the regular grate Kewanee fire-box boiler an efficiency ranging from 62.39% to 68.6% could be secured. With Kewanee smokeless boilers the lowest efficiency obtained was 73.86% and it ranged from that figure to 81.38%. Full details of the tests are included, covering some 52 items. Another recent folder issued by this company states that 143 miles of buildings in Chicago are heated with Kewanee steel boilers. It is also stated that for 25 years the company has been making Kewanee boilers of steel and a careful record of repairs shows that repairs average $1.50 a year per boiler.

Peco Vacuum System of Steam Heating and its general advantages are covered in a well-designed catalogue issued by the Pittsburgh Engineering Co., Pittsburgh, Pa. The principal elements of this system are the Peco thermal valve, controlling the steam supply to the radiator and designed for one-pipe as well as two-pipe systems; and the Peco vacuum trap for withdrawing the air and water. The company also makes an interesting type of float valve for the same purpose of removing the condensation and air, and other accessories that go to make up a complete modulation and vacuum heating systems. The Peco thermal valve has a diaphragm on the return side of the seat which closes against the steam, instead of being in the steam. This prevents the collapse of the diaphragm through pressure, and also adds to the sensitiveness of the trap. The diaphragm is filled with a chemical liquid when under a vacuum. This insures an even expansion governed by the temperature applied. This expansion member being filled, it cannot be affected by pressure as the fluids cannot be compressed, nor will a vacuum affect it, as the fluids cannot be stretched. A large section of the catalogue is given over to some of the more important installations of the Peco system. Size 6 x 9 in. Pp. 39.



PECO THERMAL VALVE.

How To Tell Genuine Wrought-Iron Pipe is the title of an interesting folder received from the A. M. Byers Co., Pittsburgh, Pa., calling attention also to some notable service records to the credit of Byers wrought-iron pipe. The procedure is to cut three or four sample rings, preferably from different pieces of pipe. Submerge one ring in a solution consisting (by volume) of 25% hydrochloric acid, C. P. 1.19 sp. gr.; 25% sulphuric acid, C. P. 1.84 sp. gr.; 50% water. Leave in solution about 1 min., rinse sample in cold water and then in alcohol. Examine ring at both ends to discover bright streaks, which are indications of steel. Three or four rings cut from different pieces of pipe will usually show steel scrap, if it is present. File a flat on the outside of the ring where the steel, according to the end indications, is most likely to be found. Stop filing when the steel band or bands are half filed away. Re-etch the flat, keeping the sample in solution 1 min. or as long as necessary to bring out the steel bands in strongest relief. If in doubt as to whether or not the bright streaks are steel, polish the surface, etch with 5% picric acid solution in alcohol, and examine under a microscope. Another recent folder issued by the A. M. Byers Company shows an impressive array of Pittsburgh buildings equipped with Byers pipe.

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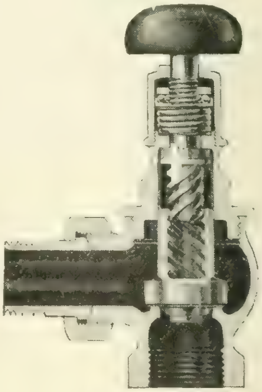
New Design of Dole Packless Radiator Valve.

The accompanying illustration shows the latest design of the Dole packless radiator valve. No change has been made in the principle of the design, but its appearance has been improved by cutting down the length of the stem. This change has been made on the entire line of Dole valves, which are manufactured by the Dole Valve Co., 208 North Fifth Avenue, Chicago, Ill.



NEW DESIGN OF DOLE PACKLESS RADIATOR VALVE.

HEAT LOSS CO-EFFICIENTS (CE).

(B.T.U. LOSS PER SQUARE FOOT, PER DEGREE F., PER HOUR).

TERRA COTTA OR TILE WALLS

		Temperature Difference, Deg. F.									
Thickness in Inches. Tile, Plain.	CE	35	40	45	50	55	60	65	70	75	80
4	0.79	27.6	31.6	35.5	39.5	43.4	47.2	51.3	55.3	59.2	63.2
8	0.56	19.6	22.4	25.2	28.0	30.8	33.6	36.4	39.2	42.0	44.8
12	0.44	15.4	17.6	19.8	22.0	24.2	26.4	28.6	30.8	33.0	35.2
16	0.40	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0
20	0.33	11.5	13.2	14.8	16.5	18.1	19.8	21.4	23.1	24.7	26.4
TILE AND STUCCO											
4	0.75	26.2	30.0	33.7	37.5	41.2	45.0	48.7	52.5	56.2	60.0
8	0.54	18.9	21.6	24.3	27.0	29.7	32.4	35.1	37.8	40.5	43.2
12	0.41	14.3	16.4	18.4	20.5	22.5	24.6	26.6	28.7	30.7	32.8
16	0.37	12.9	14.8	16.6	18.5	20.3	22.2	24.0	25.9	27.7	29.6
20	0.31	10.8	12.4	13.9	15.5	17.0	18.6	20.1	21.7	23.2	24.8
TILE, STUCCO AND PLASTER											
4	0.34	11.9	13.6	15.3	17.0	18.7	20.4	22.1	23.8	25.5	27.2
8	0.27	9.4	10.8	12.1	13.5	14.8	16.2	17.5	18.9	20.2	21.6
12	0.26	9.1	10.4	11.7	13.0	14.3	15.6	16.9	18.2	19.5	20.8
16	0.23	8.0	9.2	10.3	11.5	12.6	13.8	14.9	16.1	17.2	18.4
20	0.20	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0

B. T. U.—TILE **NO. 1—D**

Copies of this sheet, printed separately; 5 cents each.

HEAT LOSS CO-EFFICIENTS (CE).

(B.T.U. Loss per square foot, per degree F., per hour.)

Frame Walls of—		Temperature Difference, Deg. F.									
	CE	35	40	45	50	55	60	65	70	75	80
Studs covered as follows:											
1 side L. & P.	0.60	21.0	24.0	27.0	30.0	33.0	36.0	39.0	42.0	45.0	48.0
2 sides L. & P.	0.34	11.9	13.6	15.3	17.0	18.7	20.4	22.1	23.8	25.5	27.2
1 side Clapboards	0.47	16.4	18.8	21.1	23.5	25.8	28.2	30.5	32.9	35.2	37.6
1 side Clapboards and 1 L. & P.	0.44	15.4	17.6	19.8	22.0	24.2	26.4	28.6	30.8	33.0	35.2
1 side Paper and Clapboards	0.34	11.9	13.6	15.3	17.0	18.7	20.4	22.1	23.8	25.5	27.2
1 side Paper and Clapboards and 1 L. and P.	0.31	10.8	12.4	13.9	15.5	17.0	18.6	20.1	21.7	23.2	24.8
1 side Clapboards and Sheathing	0.30	10.5	12.0	13.5	15.0	16.5	18.0	19.5	21.0	22.5	24.0
1 side Clapboards and Sheathing and 1 L. and P	0.27	9.4	10.8	12.1	13.5	14.8	16.2	17.5	18.9	20.2	21.6
1 side Clapboards and Sheathing and Paper	0.26	9.1	10.4	11.7	13.0	14.3	15.6	16.9	18.2	19.5	20.8
1 side as above and 1 side L. and P.	0.23	8.0	9.2	10.3	11.5	12.6	13.8	14.9	16.1	17.2	18.4
Clapboards Brick Lined and P.	0.22	7.7	8.8	9.9	11.0	12.1	13.2	14.3	15.4	16.5	17.6

NOTE—L indicates lath and P, plaster.

Copies of this sheet, printed separately; 5 cents each.

HEAT LOSS CO-EFFICIENTS (CE).

(B.T.U. Loss per square foot, per degree F., per hour.)

GLASS

		Temperature Difference, Deg. F.									
	CE	35	40	45	50	55	60	65	70	75	80
Windows—Single-Thick	1.00	35.0	40.0	45.0	50.0	55.0	60.0	65.0	70.0	75.0	80.0
Windows—Double-Thick	0.62	21.7	24.8	27.9	31.0	34.1	37.2	40.3	43.4	46.5	49.6
Windows—Double	0.56	19.6	22.4	25.2	28.0	30.8	33.6	36.4	39.2	42.0	44.8
Skylight—Single	1.16	40.6	46.4	52.2	58.0	63.8	69.6	75.4	81.2	87.0	92.8
Skylight—Double	0.48	16.8	19.2	21.6	24.0	26.4	28.8	31.2	33.6	36.0	38.4

Doors Same as single-thickness glass.

PARTITIONS

Wire Lath and Cement Plaster 1½ in.-2½ in. thick	0.61	21.3	24.4	27.4	30.5	33.5	36.6	39.6	42.7	45.7	48.8
Ditto, 3 in.-3½ in. thick	0.49	17.1	19.6	22.0	24.5	26.9	29.4	31.8	34.3	36.7	39.2
Corrugated Iron, Unlined	0.84	29.4	33.6	37.8	42.0	46.2	50.4	54.6	58.8	63.0	67.2

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THE HEATING AND VENTILATING MAGAZINE — 1123 BROADWAY — N. Y. CITY.

HEAT LOSS CO-EFFICIENTS (CE).

(B.T.U. loss per square foot, per degree F., per hour.)

		Temperature Difference, Deg. F.									
Ceilings	CE	35	40	45	50	55	60	65	70	75	80
Lath and Plaster only	0.62	21.7	24.8	27.9	31.0	34.1	37.2	40.3	43.4	46.5	49.6
Fire proof floor as ceiling	0.20	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
Also see "Floors"											
Floors											
Dirt	0.23	8.0	9.2	10.3	11.5	12.6	13.8	14.9	16.1	17.2	18.4
Wood on ground	0.10	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
Wood on concrete	0.10	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
Cement on Tile	0.30	10.5	12.0	13.5	15.0	16.5	18.0	19.5	21.0	22.5	24.0.
Single Wood on Joists	0.45	15.7	18.0	20.2	22.5	24.7	27.0	29.2	31.5	33.7	36.0
Double Wood on Joists	0.31	10.8	12.4	13.9	15.5	17.0	18.6	20.1	21.7	23.2	24.8
Single Wood L. and P. on Joists	0.26	9.1	10.4	11.7	13.0	14.3	15.6	16.9	18.2	19.5	20.8
Double Wood L. and P. on Joists	0.18	6.3	7.2	8.1	9.0	9.9	10.8	11.7	12.6	13.5	14.4
Concrete on Brick Arch	0.20	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
Wood on Brick Arch	0.15	5.2	6.0	6.7	7.5	8.2	9.0	9.7	10.5	11.2	12.0
Dbl. Wood on Brick Arch	0.10	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
Roofs											
Unlined Slate	0.80	28.0	32.0	36.0	40.0	44.0	48.0	52.0	56.0	60.0	64.0
Slate on T. and G. Boards	0.30	10.5	12.0	13.5	15.0	16.5	18.0	19.5	21.0	22.5	24.0
Iron on T. and G. Boards	0.17	5.9	6.8	7.6	8.5	9.3	10.2	11.0	11.9	12.7	13.6
Unlined Metal Roof	1.30	45.5	52.0	58.5	65.0	71.5	78.0	84.5	91.0	97.5	104.0
Patent Tar and Gravel on Tar and Gravel Bed	0.30	10.5	12.0	13.5	15.0	16.5	18.0	19.5	21.0	22.5	24.0
Tiling 1 in. thick	0.80	28.0	32.0	36.0	40.0	44.0	48.0	52.0	56.0	60.0	64.0
6-in. Tile, 2-in. Concrete and Tar and Gravel Roofing	0.36	12.6	14.4	16.2	18.0	19.8	21.6	23.4	25.2	27.0	28.8
8-in. tile, 1-in. Concrete and Tar and Gravel Roofing	0.40	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.0	30.0	32.0
4-in. Concrete, Cinder Fill and Tar and Gravel Roofing	0.60	21.0	24.0	27.0	30.0	33.0	36.0	39.0	42.0	45.0	48.0
6-in. Concrete, Cinder Fill & Tar & Gravel Roofing	0.54	18.9	21.6	24.3	27.0	29.7	32.4	35.1	37.8	40.5	43.2

B. T. U.—CEILING, FLOOR AND ROOF **NO. 1—C**

Copies of this sheet, printed separately; 5 cents each.

Binders for Heating and Ventilating Data Sheets.

Binders are now ready for preserving the data sheets on heating and ventilation, which began publication in THE HEATING AND VENTILATING MAGAZINE for February. As announced last month, these sheets should be trimmed along the outer line. When placing them in the binder the left-hand end will serve as a binder strip. An additional cutting line is provided, so that the sheets may be still further trimmed to a size 8 x 5 in., which is a standard size for card-index filing.

BINDER FOR STANDARD HEATING DATA SHEETS.

It will be noted from the accompanying illustration of the binder that it is substantially made with a spring clip and is bound in brown duck. The cover is suitably stamped in black, instead of gold. The binders may be had at $1.00 postpaid. They are now ready for delivery.

◆

Plan to Establish New York Heating Center in Grand Central Palace.

A project is being developed by the management of the Grand Central Palace, Lexington Avenue and 47th Street, New York, to establish a new heating and ventilating center in that building. The idea is to divide one or more floors into offices, located along the outside walls and reserve the central portion of each floor for a display of heating and ventilating apparatus. Each floor of this building contains 50,000 sq. ft.

The furniture manufacturers' exchange is located in this building and it is proposed to model the proposed new heating exchange on the same general lines.

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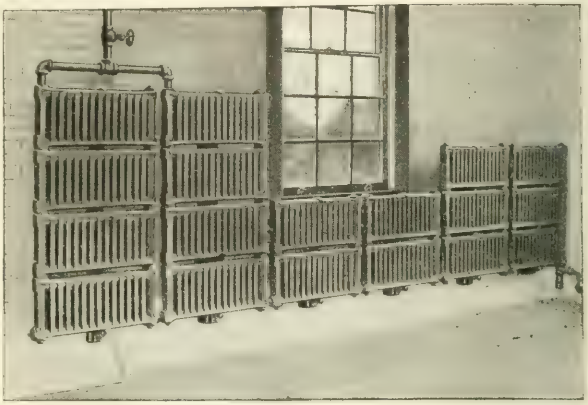

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The Heating and Ventilating Magazine

VOL. XIV. NO. 4

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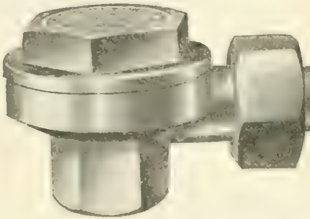

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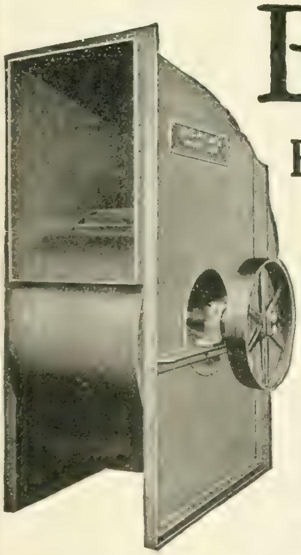

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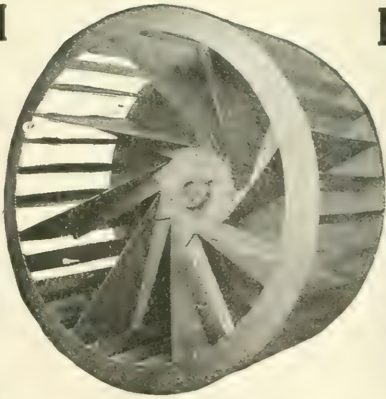

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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. APRIL, 1917 1123 Broadway, New York

Up-to-Date Methods of Selling Steam

How the Largest Central Heating Company in the United States Goes After New Business.

By CLAUDE HARTFORD,
Sales Engineer, Contract Department, New York Steam Company.

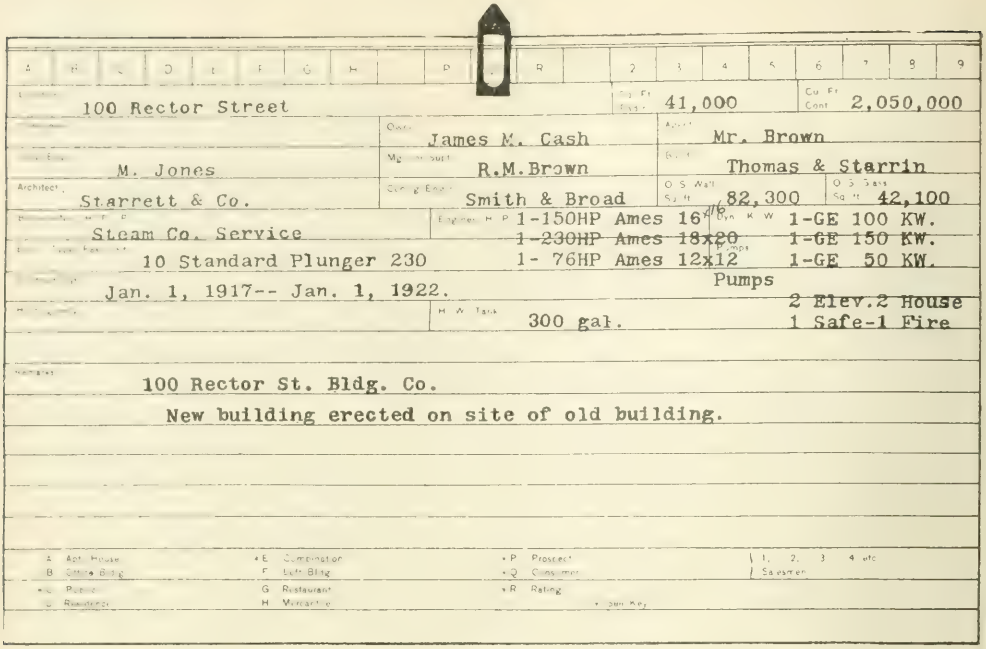
When the New York Steam Company, which, by the way, is the oldest public service corporation in the city and the largest central station steam company in the world, passed into the hands of the new interests that now control it, two years ago, one of the first things that happened was the total rehabilitation of its plants and distribution system. This was followed, in short order, by the organization of a "Contract Department," in which a system was installed for maintaining a complete record of data relative to both new and old business. So much new business has been obtained under this method and so well distributed a load secured that the details of the system should prove of value to all who are interested in the sale of district heat. The inception of the plan is due to Charles H. Gillham, vice-president of the company, whose long experience in the central heating field recently in New York and previously as vice-president of the Central Station Engineering Company, of Chicago, has enabled him to incorporate the best features of other heat selling schemes in the method here described.

In presenting the company's sales record system, it should be understood that the company operates two systems in New York City, one in the down-town financial district where steam is served to a majority of the most important business buildings; and the other uptown, serving what has been described as "the most exclusive residential district in the world."

It may not be generally known that in the down-town district most of the office buildings have their own plants for the generation of electrical current for both power and light. These buildings take steam from the street service to drive their generating engines. After years of service, this method has proved both practical and economical. Due to the increased demand for such service, a new station is nearing completion at Burling Slip and Water Street, of 24,000 H.P. capacity, which is the last word in engineering, from the standpoint of both construction and operation.

Due to the division of the company's service into two systems and to the different class of service rendered, for the most part, by each system, it was necessary, in the first place, to have the sales records divided in the same way.

A card and map system is used, Figs.



A B C D E F G H P Q R 2 3 4 5 6 7 8 9

100 Rector Street | Sq Ft 41,000 | Cu Ft Cont 2,050,000

Owner James M. Cash | Agent Mr. Brown

M. Jones | Mg. Supt R.M.Brown | Thomas & Starrin

Architect Starrett & Co. | Cons'g Eng. Smith & Broad | O S Wall Sq ft 82,300 | O S Glass Sq ft 42,100

Steam Co. Service | Engines H P 1-150HP Ames 16 | Dyn K W 1-GE 100 KW.

~~1-230HP Ames 18x20~~ ~~1-GE 150 KW.~~

10 Standard Plunger 230 | 1- 76HP Ames 12x12 | Pumps 1-GE 50 KW.

Jan. 1, 1917-- Jan. 1, 1922. | Pumps

H W Tank 300 gal. | 2 Elev.2 House 1 Safe-1 Fire

Remarks 100 Rector St. Bldg. Co.

New building erected on site of old building.

A Apt. House · B Office Bldg · C Public · D Residence · E Combination · F Loft Bldg · G Restaurant · H Mercantile · P Prospect · Q Consumer · R Rating · Sub Key · 1, 2, 3, 4 etc Salesmen

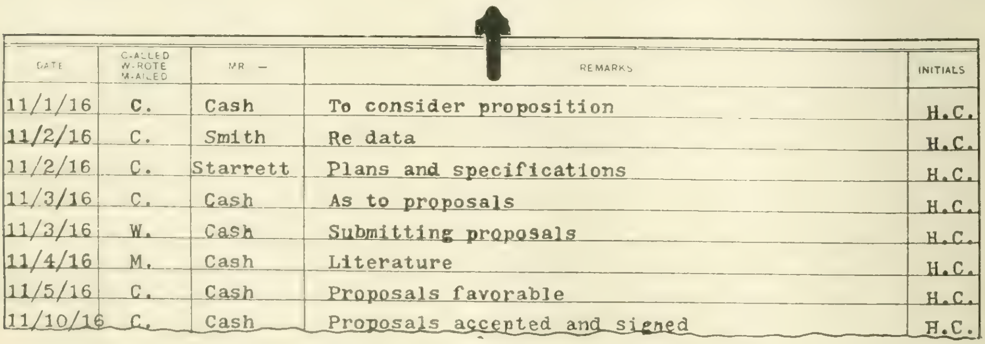
FIG. I—FRONT OF SALES RECORD CARD, WITH TYPICAL ENTRY.

1 and 2 being reproductions of the front and back of a typical card. These cards measure 5 in. x. 8 in., being of standard size for filing. For the up-town district a salmon-colored card is used, while that for the down-town district is buff-colored. On the face of the card, as will be noted are recorded all the necessary data, as shown under the various headings.

At the top of the cards, in the center, will be seen the letters "P" and "Q." "P" indicates a prospect and "Q" indicates a consumer. Metallic signals are employed to designate the classification of any particular card. In the illustration, for instance (Fig. 1), the signal is over "Q" showing that this particular party is a consumer.

Other signals are provided for use on the cards. A green signal indicates a power consumer; a yellow signal indicates a heating consumer; a red signal shows a power prospect and a blue signal stands for a heating prospect. As every card has one signal on it and that one is placed on either the "P" or the "Q," the contrast of consumers against prospects in the card file is readily seen.

There is a card for every building plot on every main. The cards are filed alphabetically by streets, the street names



DATE	C-ALLED W-ROTE M-AILED	MR —	REMARKS	INITIALS
11/1/16	C.	Cash	To consider proposition	H.C.
11/2/16	C.	Smith	Re data	H.C.
11/2/16	C.	Starrett	Plans and specifications	H.C.
11/3/16	C.	Cash	As to proposals	H.C.
11/3/16	W.	Cash	Submitting proposals	H.C.
11/4/16	M.	Cash	Literature	H.C.
11/5/16	C.	Cash	Proposals favorable	H.C.
11/10/16	C.	Cash	Proposals accepted and signed	H.C.

FIG. 2—BACK OF SALES RECORD CARD, WITH TYPICAL ENTRY.

being printed on regular cardboard card indexes. Under each street the cards are filed numerically, according to lot numbers. It has been found that in looking up a proposition the location of the consumer or prospect is known, and hence the foregoing method of filing.

The numerals at the top of the card, on the right (Fig. 1) are used to designate the sales engineer who has charge of the prospect. The various prospects on the mains are assigned to the different sales engineers and a white duplicate of the master card is given each one of them. On the back of the card (Fig. 2) space is provided for notes as to dates, persons interviewed or written to, literature sent, remarks and initials of the sales engineer. The notes made on the white card are regularly transferred to the master cards.

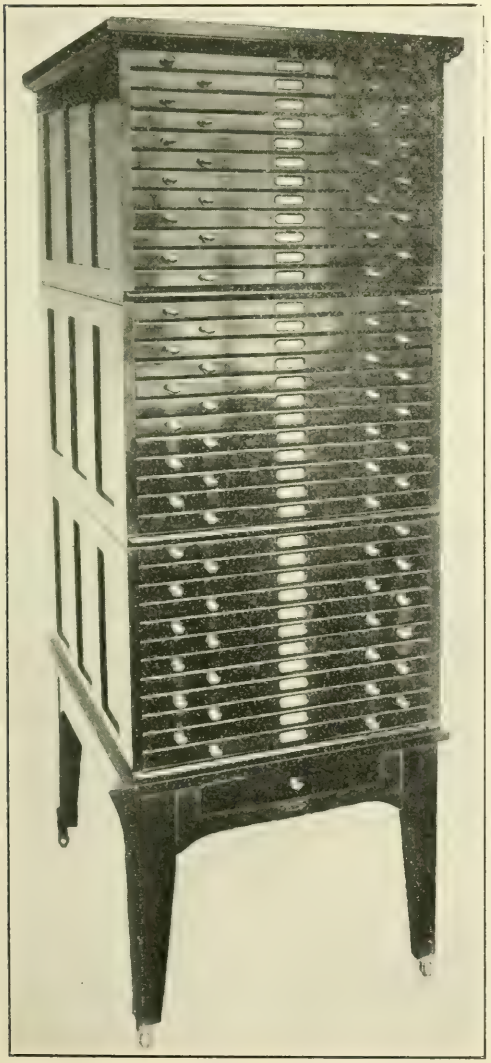


FIG. 3—MAP CABINET FOR DOWNTOWN DISTRICT.

In the typical case illustrated in Fig. 1, the data show the principal facts regarding the building at 100 Rector Street, New York, including the contents, 2,050,000 cu. ft.; the radiation, 41,000 sq. ft.; owners, etc. It will be noted that the building has no boilers, being supplied by steam company service.

On the back of the card (Fig. 2) the record shows that the proposition was first brought to the owner's attention on November 1, 1916 by a personal call. On the 2nd, the representative called on the consulting engineer to obtain the data afterwards listed on the front of the card. The same day, the representative called on the architect to obtain plans and specifications. On the 3rd, the representative called "as to proposals, and on his return to the office wrote the owner, submitting the company's proposals. The next day he mailed the owner some literature bearing on the proposition. He called the next day to find that the proposals were being favorably considered by the owner of the building and five days later, on November 10, the contract was closed during a personal call.

The map system used in conjunction with the cards is very elaborate in detail. These maps are kept flat in cabinets. For the down-town district there are 34 maps in as many drawers. Fig. 3 shows one of the cabinets which is located conveniently in a corner of the "Contract Department."

In the first drawer of each cabinet is an index map (Fig. 4) with a key (Fig. 6) showing in what drawer to look for the detailed map of any particular section. Fig. 5, for instance, is a detail map of Section 11, filed in drawer No. 11. The maps show by symbols, colors, etc., all data relative to the various buildings upon the lots, besides the size and location of steam mains and services.

In addition to this, a vital feature of the system is the use of different-colored tacks, the colors corresponding with those on the signals in the card file.

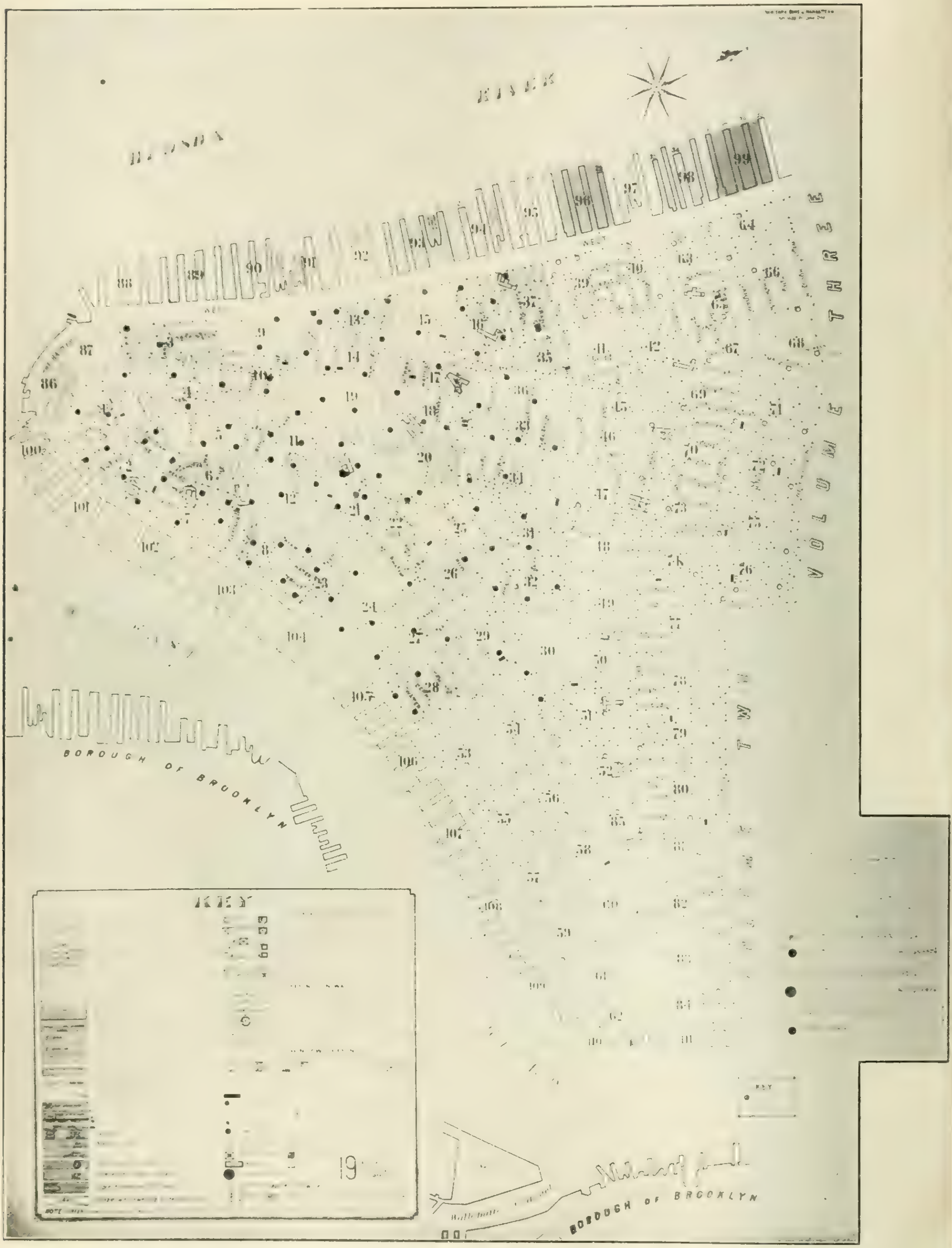


FIG. 4—KEY MAP OF DOWNTOWN DISTRICT, NEW YORK CITY AS COMPILED BY NEW YORK STEAM COMPANY.

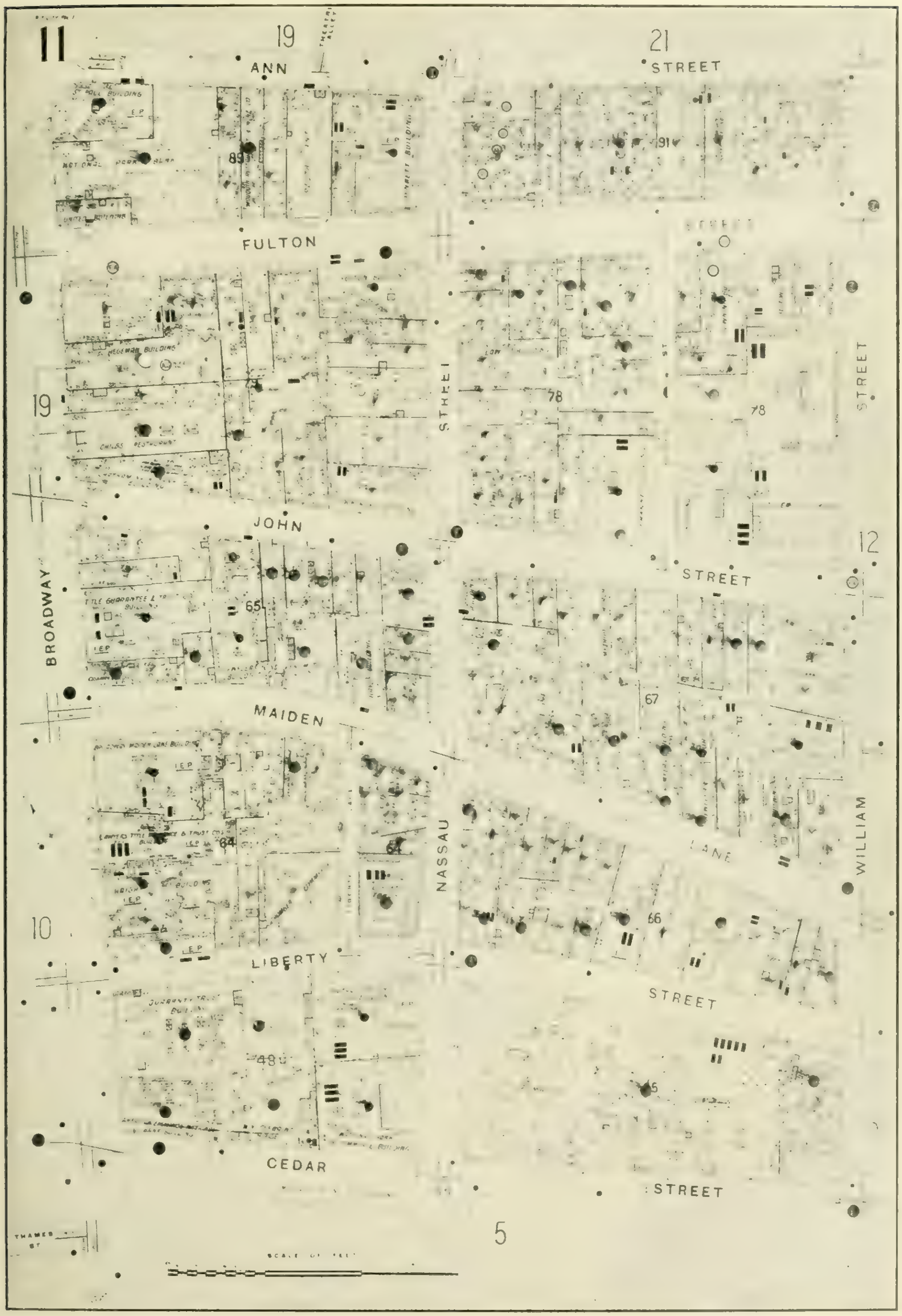


FIG. 5—MAP OF SECTION II, DOWNTOWN DISTRICT, NEW YORK CITY, WITH PIN INDICATIONS TO SHOW PRESENT AND PROSPECTIVE SERVICE.

Fig. 5, for instance, illustrating Section 11 of the down-town district, is honeycombed with tacks that tell, at a glance, the exact conditions relative to the use of central station heat and power of any building in that section. As a further contrast the tacks used for consumers are round, flat and cloth-covered, while those indicating prospects are glass spheres of smaller diameter.

Where the company's service is connected to a building with no consumer as, for example, where a consumer moves out, a white glass tack is placed on that building, besides the red and blue tack, for further contrast. The "object of the game" is to replace all red, white and blue tacks with green and yellow tacks.

When the sales engineer turns in a signed contract from a new consumer, the signals are at once changed on the card file from the "Prospect" to the "Consumer" side and the contract date noted in the space provided. Then the "Prospect" tack on the map is changed to a "Consumer" tack and the service pipe drawn in on the map, if the building has not one already installed. In this manner an orderly, up-to-the-minute record is kept of the development of the business.

This system has proved very satisfactory and is in keeping with the other developments in the reorganization of the New York Steam Company, which are making for its success. The advantage of the system is that it tells at a glance the exact conditions in any section or building and may be understood and used not only by the salesmen themselves but by all the officials of the company who may require such information.

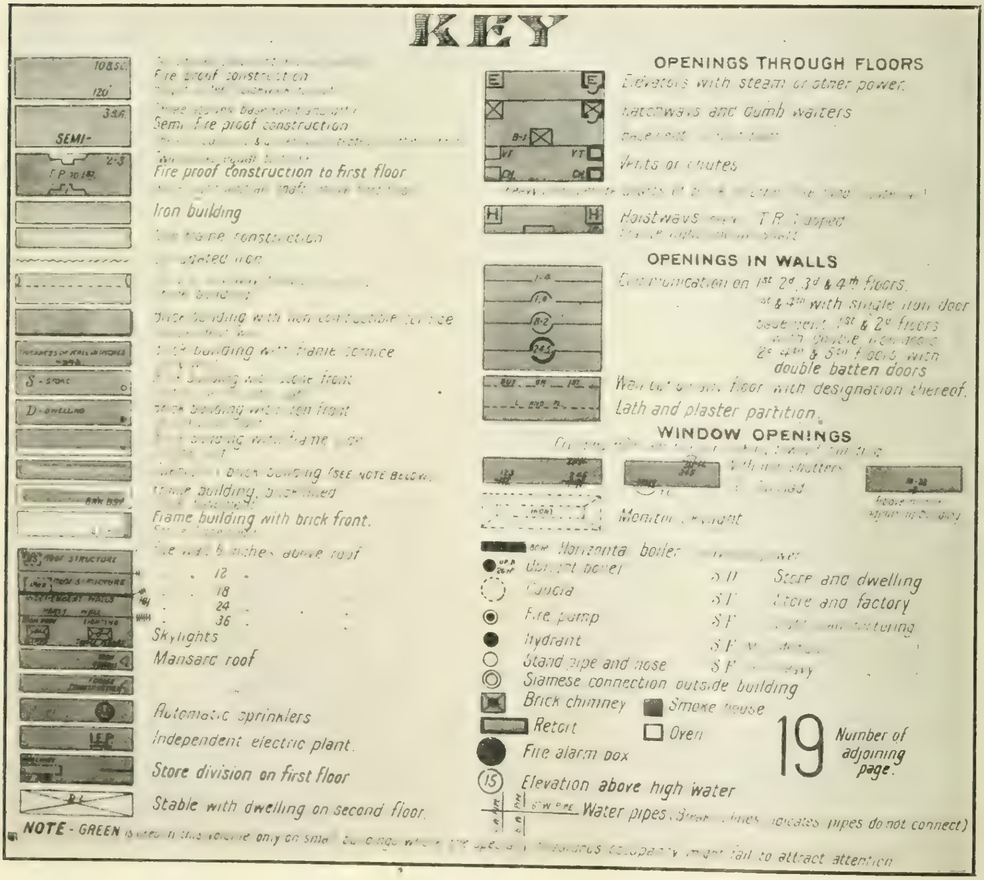

KEY
Fire proof construction
Semi fire proof construction
SEMI-
Fire proof construction to first floor
Iron building
Frame building with brick front.
Skylights
Mansard roof
Automatic sprinklers
Independent electric plant.
Store division on first floor
Stable with dwelling on second floor.
NOTE - GREEN
OPENINGS THROUGH FLOORS
Elevators with steam or other power.
Hatchways and dumb waiters
Vents or chutes
Hoistways
OPENINGS IN WALLS
Communication on 1st 2d 3d & 4th floors.
double batten doors
Lath and plaster partition.
WINDOW OPENINGS
Monitor
Horizontal boiler
Cupola
Fire pump
Hydrant
Stand pipe and hose
Siamese connection outside building
Brick chimney
Smoke house
Retort
Oven
Fire alarm box
Elevation above high water
Water pipes
pipes do not connect)
Store and dwelling
Store and factory
19
Number of adjoining page.

FIG. 6—KEY TO SECTION MAPS.

A Method of Determining the Probable Steam Consumption of a Building, under Given Conditions, from Central Service

By F. O. BROILI,

Northwestern Electric Co., Portland, Ore.

As is well known, the amount of heat required for buildings depends on a number of factors, and one of the important items is the class of service given, and the personal equation of the man (or men) in charge of the operation of the heat service.

For this reason, any formula that might be devised to determine the amount of heat required can be rendered worthless by a change of janitors. However, where there is no change of the class of service, and where reasonable care is given to maintain a uniform temperature, a formula for the requirements of the Northwestern Electric Company has been devised which appears to give excellent results for the short time it has been used.

It is sometimes necessary to know about what the consumption of a building should be between meter readings, where the meter has stopped. It is also necessary sometimes to explain to an irate customer why his bills have increased with a decrease in temperature, or why they should be higher or lower one year or one month as compared with another year or month.

The formula below is not intended to determine the amount of heat that would be required by a building, unless it has already been supplied with heat in some measurable form. The formula has been designed to apply to steam heat, but can be applied to any heat agent by slight changes.

The period "A," mentioned below, may be one week or one month or longer, as circumstances determine. Usually, the calculations are intended for monthly comparisons,—in which case it is important that the actual number of days be correctly determined.

The factors V_1 and V_2 are based upon average wind movement during the period in question, and these data are obtained from the U. S. Weather Bureau. It appears, from our investigations, that a wind under six miles per hour has little or no effect upon the heat requirements of a building.

The temperatures are obtained from the U. S. Weather Bureau, and care is taken that the average of the hourly readings is obtained. The published data of the Weather Bureau for the last few years is simply the average of

Formula for Determining Amount of Steam Required for a Given Period in Buildings Already Supplied with Heat.

M_1 = average amount of steam metered during period "A."

M_2 = probable average amount of steam used for a period "B."

T_1 = mean of hourly temperature for period "A."

T_2 = mean of hourly temperature for period "B."

V_1 = average wind velocity above 6 miles per hour during period "A."

V_2 = average wind velocity above 6 miles per hour during period "B."

W_1 = auxiliary consumption per day during period "A" and including steam for hot water, cooking, etc. This factor is not necessarily constant and will vary on certain classes of buildings and with certain types of installation.

W_2 = auxiliary consumption per day during period "B." This factor can be the same as W_1, but in many cases will vary with the time of the year for the period "B" selected.

$E_1 = (65 - T_1 + V_1)$ = equivalent temperature for period "A." This includes the variables that specifically affect the steam consumption; and, in effect, is the average equivalent temperature below 65° F.

$E_2 = (65 - T_2 + V_2)$ = equivalent temperature for period "B," based on variables used for period "A."

$S = \frac{M_1 - W_1}{E_1}$ = specific consumption. This is the consumption per day for each equivalent drop in temperature per degree Fahrenheit below 65°.

$M = SE_2 + W_2$.

the maximum and the minimum temperature during every 24-hour period.

The auxiliary consumption of W_1 and W_2 are the hot water requirements, etc., and which are independent of the actual heating requirements of the building. This amount can vary between summer and winter, depending upon the nature of the apparatus used. Many buildings are connected up so that the condensate heats all, or nearly all, of the hot water required for the building in the winter time; but in the summer time steam is required. In other cases (hotels, for instance), a practically constant amount of steam is used for cooking purposes. For this reason, judgment should be exercised so that consistent factors are obtained.

No claim is made for absolute accuracy, the formula merely giving results that connot be as readily obtained in any other manner. To show its application, the following are examples:

APPLICATION OF FORMULA.

A public building has been heated with its own system, and the amount of steam required measured. Upon taking service from the central station company, the consumption was about 30% higher. A comparison of a year with their own operation, and calculated requirements for the succeeding year, and the actual amount, were as shown in the table.

W_1 was summed as being 1,300 lbs. as that was the amount used during 1916 in August, and was used for hot water, the only auxiliary load.

It will be noted that the actual requirements are somewhat higher than the calculated totals, but this is explainable by the fact that a 2° higher temperature was maintained. This would have taken even more steam, but for the fact that the condensate, in the case of the central station service plant, was used in economy coils and it was estimated that one item about cancelled the other.

APPLYING FORMULA WHEN METER HAS STOPPED.

In the following case, the meter had stopped between the two 10-day meter reading intervals, and it was felt necessary to have some "educated" guess, so the formula was applied from the following data and with the results as given.

During period "B," December 30 to January 11, 1917, the steam metered was 137,000 lbs., but the meter was found stopped, (E_2 = 22.5) January 11 to 22. Applying the formula for this period gave 210,000 lbs.

STEAM REQUIRED FROM PRIVATE PLANT TO HEAT A GIVEN BUILDING COMPARED WITH THE CALCULATED AND ACTUAL AMOUNTS WHEN SUPPLIED FROM A CENTRAL HEATING PLANT

1915 M'th	No. Days	Actual Consumption 1915, 1,000 lbs.	E_1 1915	Per Cent	E_2 1916	No. Days 1916	Estimated Cons'ption 1916 $SE_2+W_2 \times N$	Actual Cons'ption 1916, 1,000 lbs.
Jan.	31	920	26.5	1,060	38.2	31	1,395	1,361
Feb.	28	715	20.1	1,200	24.3	29	844	867
Mar.	31	455	12.9	1,040	20.0	31	750	807
Apr.	30	346	10.2	970	13.2	30	495	474
May	31	325	7.9	1,180	11.6	31	452	362
June	30	165	3.0	1,400	3.6	30	163	188
July	31	gas	. . .		1.6	31	97	68
Aug.	31	gas	. . .		0.0	31	40	40
Sept.	30	137	3.9	845	3.5	31	164	122
Oct.	31	404	9.8	1,190	12.6	30	473	607
Nov.	30	725	20.1	1,140	23.0	30	830	864
Dec.	31	882	23.8	1,140	27.7	29	960	1,018
		5,074					6,662	6,778

S = 1145.

N = Number of days.

Average of January, February, November and December, 1915 = 1,145. Use this for S for 1916.

$E_1 = 29.5.$

$$S = \frac{210,000}{11 \times 29.5} = 645.$$

January 22 to February 1, the amount of steam metered was 172,000 lbs.

$E_1 = 25.7.$

$$S = \frac{172,000}{10 \times 25.7} = 665.$$

$$\frac{645 + 665}{2} = \text{Average } S,\ 655.$$

Consumption during period B = 665 × 12 × 22.5 = 177,000 lbs.

The total meter reading was increased 40,000 lbs. for the month, or 177,000 lbs.—137,000 lbs. and the consumer admitted the justice of our charge.

Chimneys: Their Design and Construction

2—Designing Data.

By HAROLD L. ALT.

For heating plants in larger buildings the design of the chimney approaches that of the stacks used for power plants and the quality of fuel is quite liable to be of more or less inferior grade. Under such conditions the height and area become of prime importance since upon the proper size and height of a chimney depend the satisfactory operation of the entire heating plant. It is the purpose of the balance of this article to deal with the numerous factors entering into the matter of sizing the chimneys in a practical manner and with the avoidance, as far as possible, of all the complicated calculations usually found involved in such design.

FRICTION LOSSES.

It must be understood that a chimney or stack filled with hot air or heated gases has a lower pressure at its base than the outside air, owing to the tendency of the heated gases to rise. Now this tendency to ascend is what is known as the "theoretical draft" and its calculation is comparatively simple; the trouble is that as soon as the gas actually commences to rise the element of friction comes into play, this friction being the result of the rubbing of the gases against the sides of the chimney and varying according to the weight of the gases and the velocity with which they pass along the surface. This friction also depends upon the length and quality of the surface passed over—otherwise the height of the chimney. For a given set of conditions this friction can also be computed and the "theoretical draft" less the "friction loss in the stack" will give the "available draft" at the base of the stack.

But this is not the only friction loss which must be overcome by the chimney "theoretical draft." The other losses consist of the friction of the air passing through the fire, all around the gas passages of the boiler, the resistance of the bends into the breeching, in passing along the breeching, and the bend into the chimney itself.

The total draft necessary (*i.e.*, "theoretical draft") must be equal to, or greater than, the sum of all the friction losses encountered by the air from the time it enters the ash pit until it leaves the top of the stack so that, besides the friction loss in the stack itself, other losses must be considered. Such losses are usually expressed in inches of water and are so treated in this discussion.

The first of these losses and one of the most variable encountered is the loss of draft in passing through the grates and fire bed. This varies with the fuel, its size, and the quantity it is desired to burn per square foot of grate. This quantity per square foot of grate is in turn governed by the efficiency of the boiler, the horsepower of the boiler and the desired amount of overload to be provided.

In order to give the designer an idea of the various draft losses encountered and of the number of pounds of coal required for any set of conditions Tables III and IV have been prepared, Table III being the number of pounds of coal per hour for the development of various horsepowers at several rates (4 to 7 lbs.) of pounds of coal per boiler horsepower developed. In the right-hand column is shown the number of pounds of air per second necessary for the combustion of the required coal to produce this horsepower, the reason for rating this air in pounds per second being for greater facility in applying formulas to the chimney friction loss, as will be seen later. The number of cubic feet per pound of coal upon which these pounds of air are computed consist of 18 lbs. of air to every pound of coal or about 250 cu. ft. per pound which is a fair and average air consumption in the combustion of this fuel.

It should be noted that the H.P. readings in Table III are actual horsepower deveolped and *not* the rated horsepower of the boiler. Thus if a 200 H.P. boiler was expected to carry 50% overload its maximum developed horsepower would be 200 + 0.50 × 200 = 300 H.P. and this is the amount to be considered in the table.

Table IV is the draft loss encountered for various rates of combustion when applied to the commoner forms and sizes of anthracite and bituminous coal and represent average firing conditions. It is entirely possible to bank a fire so heavily with fuel that the draft loss is greatly increased or to keep the fuel bed so thin as to reduce the draft loss, thereby increasing the rate of combustion. Neither of these extremes is desirable, however, and Table IV represents average desirable firing conditions.

TABLE III.—REQUIRED POUNDS OF COAL AND AIR FOR HORSEPOWERS AT VARIOUS EFFICIENCIES.

TOTAL LBS. OF COAL	POUNDS OF COAL PER BOILER H. P. DEVELOPED							LBS. OF AIR PER SEC.
	4	4½	5	5½	6	6½	7	
			HORSE POWER	DEVELOPED				
50	12	11	10	9	8	8	7	0.25
100	25	22	20	18	16	15	14	0.5
150	17	33	30	27	25	23	21	0.75
200	50	44	40	36	33	31	29	1.0
300	75	67	60	55	50	46	43	1.5
500	125	111	100	91	83	77	71	2.5
750	187	167	150	136	125	115	107	3.7
1,000	250	222	200	182	167	154	143	5.0
1,500	375	333	300	273	250	231	214	7.5
2,000	500	444	400	364	333	308	286	10.0
2,500	625	555	500	455	416	385	357	12.5
3,000	750	667	600	545	500	461	429	15.0
4,000	1,000	889	800	727	667	615	571	20.0
5,000	1,250	1,111	1,000	909	833	769	714	25
7,500	1,875	1,667	1,500	1,364	1,250	1,154	1,071	38
10,000	2,500	2,222	2,000	1,818	1,667	1,538	1,429	50
15,000	3,750	3,333	3,000	2,727	2,500	2,308	2,143	75
20,000	5,000	4,444	4,000	3,636	3,333	3,077	2,857	100
30,000	7,500	6,667	6,000	5,454	5,000	4,615	4,286	150
40,000	10,000	8,889	8,000	7,273	6,667	6,154	5,714	200
50,000	12,500	11,111	10,000	9,091	8,333	7,692	7,143	250
75,000	18,750	16,667	15,000	13,645	12,500	11,538	10,714	375
100,000	25,000	22,222	20,000	18,181	16,667	15,384	14,286	500
125,000	31,250	27,778	25,000	22,745	20,833	19,230	17,857	625
150,000	37,500	33,333	30,000	27,273	25,000	23,076	21,428	750
200,000	50,000	44,444	40,000	36,363	33,333	30,768	28,576	1,000
300,000	75,000	66,667	60,000	54,545	50,000	46,154	42,857	1,500
400,000	100,000	88,887	80,000	72,727	66,667	61,536	57,143	2,000
500,000		111,111	100,000	90,909	83,333	76,923	71,428	2,500
750,000				136,455	125,000	115,380	107,143	3,750
1,000,000							142,860	5,000

TABLE IV—DRAFT LOSS IN FIRE

(In. of water)

POUNDS OF COAL PER SQUARE FOOT PER HOUR BURNED ON GRATES

FUEL	5	10	15	20	25	30	35	40	45
Anthracite									
No. 3 Buck	0.15	0.40	0.75	1.24	...	...	...	...	...
No. 1 Buck	.10	.24	.44	0.68	1.00	...	...	...	...
Pea	.06	.16	.30	.45	0.65	0.90	1.20	...	...
Bituminous									
Semi bituminous	.05	.10	.18	.26	.35	.45	0.58	0.70	0.78
Penn. Ala. Ill. & Ind.	.04	.09	.15	.22	.28	.38	.45	.55	.60
Slack	.04	.07	.10	.15	.20	.27	.34	.40	.50
Run of Mine	.04	.05	.08	.10	.14	.16	.20	.25	.32
On Chain Grate	.05	.12	.15	.23	.31	.44	.57	.75	.94

Therefore if the total produced horsepower, pounds of coal per horsepower, number of pounds of coal per square foot of grate and the kind of fuel together with its size are either known quantities or can be assumed, a fair approximation of the draft loss through the fire under these conditions can be readily determined.

Under normal conditions and efficiency it is usual to assume about 5 lbs. of coal per horsepower developed.

OTHER FRICTION LOSSES.

The next loss to be considered is that resulting from the gases passing around the various baffles and through the paths of travel maintained in the different types of boilers. Actual experiment has shown that this draft loss in water-tube boilers seldom exceeds 0.25 in. when a boiler is developing full rating; 0.40 in. when run at 50% overload; and 0.70 in. when operating at 100% overload. In horizontal return tubular boilers the loss is about 0.2, 0.3, and 0.45 in., respectively, while in vertical boilers it runs 0.1, 0.15, and 0.2 in. only. Owing to the fact that heating boilers are seldom if ever figured at being run upon any overload capacity it may be assumed that 0.25 to 0.30 in. wall cover any draft loss which the ordinary heating engineer will be required to consider. Economizers have a draft loss of about 0.3 in.

The losses resultant from the gases passing around bends after leaving the boiler are considerable and, therefore, the easier the bends of the breeching are made and the slower the velocity of the gases, the smaller will be the loss. The 90° change of direction usually made by the gases in passing from the boiler uptake into the horizontal flue and the 90° horizontal bend from the horizontal flue into the stack and the 90° change from the horizontal direction to the vertical direction in the stack itself all count against the draft and result in the certain loss. It has been found by experiment that in steel flues the loss for each right angle turn is approximately 0.05 in. and that the loss for the straight round or square flue itself due to the friction of the gases along the sides, tops and bottom is about 0.1 in. per 100 lin. ft., while in concrete flues the losses for bends of 90° are 0.1 in. and, for straight flues of 100 ft. length 0.2 inches. So that the total loss of draft say for 150 ft. of steel flue and five right angle bends between the boiler uptake and the stack, including the change of direction into the stack, will be $0.1 \times 150/100 + 0.05$ in. $\times 5$, or $0.15 + 0.25$, or 0.4 in. Having obtained all the draft friction losses up to the point where the gases enter the base of the stack it only remains to compute the friction in the stack in order to obtain the total of all friction losses.

The friction loss in the stack, however, is extremely variable in this way. For a given number of pounds of air per second passing up a stack the velocity will, of course, vary as the diameter is increased or decreased, the smaller diameter resulting in a higher velocity and a greater friction loss, and the larger diameter giving a lower velocity and a smaller friction loss. From this it is readily seen that there is a relation between the height and the diameter, one being to a more or less extent dependent upon the other. Thus, if a stack of a given height and 3 ft. in diameter has a theoretical draft of 1 in. its friction loss could also be 1 in. provided that the weight of gas to be handled were of sufficient quantity; therefore, the available draft (which has previously been shown as equal to the difference between the "theoretical draft" in the chimney and its "friction loss") would be in this case 1 in. — 1 in., or zero, so that there would be practically no pull at the base of the chimney, provided that the gas up to the quantity required were supplied from some other source. However, if the stack diameter were increased to 4 ft. the velocity would be correspondingly lessened, resulting in a falling off of the friction loss perhaps to 0.5 in., leaving 0.5 available at the bottom to overcome the other draft losses; increasing the diameter again would result in a still smaller friction loss and a still higher available draft at the base of the chimney. But how far should the increasing of the diameter be carried?

TWO METHODS OF PRODUCING DRAFT.

It must be understood that the draft can be produced in two ways. On the first chimney the "friction loss" equaling the "theoretical draft," an increase in the height would only result in a proportional increase in the "theoretical draft" and the "friction loss." Since these amounts are equal, the proportional increases will be equal and the results would be equal. On the second chimney, however, if the height were increased 50% the "theoretical draft" would be increased 50% and the "friction loss" increased 50%, resulting in the "available draft" being also increased 50% so that on the 4 ft. stack an increase could be secured for the "available draft" either by increasing the height, or increasing the diameter (using the same height), or by a combination of both. Thus it can be seen that several chimneys of varying diameters in height can be constructed, each of which would give the same "available draft" at the base when handling the same amount of gases, with all other conditions equal, it only being necessary to increase the height sufficiently to make up for the added friction when the diameter is reduced or, conversely, to increase the diameter so as to reduce the friction as the height is decreased and the "theoretical draft" therefore weakened.

DRAFT LOSSES MUST BE EQUALLED BY "THEORETICAL DRAFT."

But there is one point upon which no mistake should be made and that is that the draft losses in the fire, boiler, breeching, bends, and stack must be equalled or exceeded by the "theoretical draft" and no enlargement of a stack which is of insufficient height can ever make up for a "theoretical draft" which is less than the friction losses between the ash pit and the base of the chimney, since the chimney friction must always be *added* to these and it is not possible to produce a chimney large enough so that its friction loss will be *zero*. Therefore, a certain *height* of stack *must* be used to meet given conditions of draft loss and no increase of diameter will allow a stack of *less* height to be used.

THE QUESTION OF HEIGHT AND DIAMETER.

This brings up the point of whether it is cheaper to build a stack higher than absolutely necessary using a smaller diameter, or to build it only as high as it is absolutely necessary to meet the intensity of draft requirements and to increase the diameter accordingly. In answer to this it may be said that, where conditions permit, a stack is most economically built when made only of the height absolutely required to produce the required intensity of "available draft" and when built large enough to take care of the amount of gases to be handled with only a reasonable loss for friction. There *are* cases in high buildings where stacks must be carried up a certain distance in order to get above the roof of the building and in these instances there is no option but to use the height of stack necessary, at the same time cutting down the diameter so that the stack friction will build up a draft resistance which will counter-balance the excess of intensity and still produce the proper and desired "available draft" result in the boiler room.

REASONABLE FRICTION LOSS IN A STACK.

What, then, shall be considered as a reasonable friction loss in a stack? Experience has shown that stacks built of a sufficient diameter, so that their losses by friction amount to about 0.2 in. per 100 ft. of height, give good results and economical design. With this assumption it is now easy to compute the total draft loss for any given installation since the loss in the fire, the boiler flues, the breeching, the elbows and the stack are either known or their proper limits assumed. This total friction loss must be counter-balanced by the "theoretical draft" produced by the chimney; thus, if the sum of all the resistances equals 1 in. of water, the "theoretical draft" produced by the chimney must equal or exceed 1 in. of water in order to produce the desired results.

The "theoretical draft," as before defined, is the tendency of the heated gases in the chimney to rise without regard to the "chimney friction" and an actual reading on a draft gauge placed at the bottom of a chimney, with all inlets into the chimney closed tight and the entire contents of the chimney gases heated to the desired degree, would give this same reading provided the chimney were air tight and had absolutely no leakage. The exact force of this "theoretical draft" depends upon two things—namely, the weight of the air outside of the chimney and the weight of the gas inside. These in turn are controlled entirely by temperature and altitude.

In the ordinary heating installation, such as for residence work, the average temperature of the chimney gases is generally about 250° F. Such cases have already been considered in the first part of this discussion and are not the ones which give the most serious trouble, this section being particularly designed to cover the larger plants operating usually with steel boilers. Where cast-iron boilers are used this method will also apply if the proper draft loss for the particular type of boiler to be used is obtained from the manufacturer and substituted for the steel boiler losses given. In such installations, when run at their maximum load (*i.e.*, on a zero day) the average stack temperature will be close to 500° F. Moreover, as this occurs only in zero weather, the heating system is helped out by having the greatest temperature difference occur on the days of maximum load. The formula to compute the "theoretical draft" is

$$TD = 0.52\ H \times P\ (1/t - 1/T)$$

When TD is "theoretical draft"

H the height of the chimney in feet.

P the absolute air pressure in pounds per square inch.

T the absolute temperature of the stack gases.

t the absolute temperature of the outside air.

and 0.52 a constant.

It will be noted that this formula takes no account of the difference in densities between the gases in the stacks and the outside air, but this difference is small and the error is entirely on the side of safety. Besides this, the volatile gases from the coal will slightly increase the weight of the air assumed (although this increase will be less than 5%) and thus counterbalance, to a large extent, the difference resulting from a variation in the densities.

Fig. 5 shows the theoretical drafts produced by chimneys up to 250 ft. in height when set at various elevations from sea level up to 10,000 ft.

To find the draft loss in a stack handling any given weight of gas per second the formula is

$$L \text{ equals } \frac{fG^2CH}{A^3} \text{ in which}$$

L is draft loss in chimney in inches of water.

G the weight of gas handled in pounds per second.

C the circumference, H, the height and A the area of the chimney, all in feet.

f equals a constant, being 0.0019 for brick chimneys and 0.0014 for unlined steel stacks with flue gases at 500° F. average temperature.

Fig. 6 shows the results of this formula when computed for brick stacks or lined steel stacks 100 ft. high with the gases at 500° while Fig. 7 indicates similar curves for unlined steel stacks. In these curves the weight of gas handled is indicated in the left-hand column and

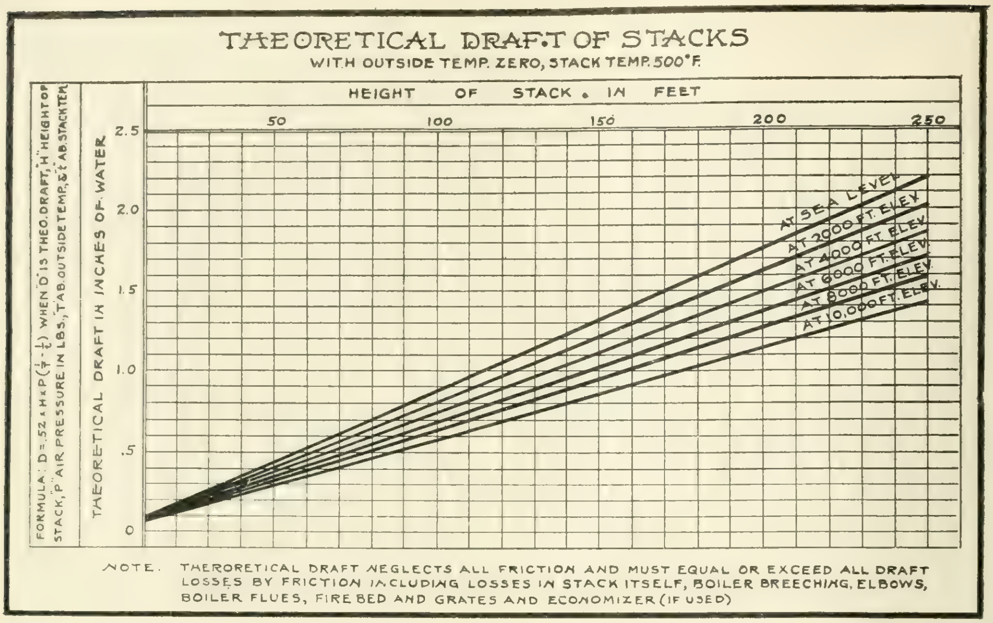


FIG. 5—THEORETICAL DRAFTS PRODUCED BY CHIMNEYS UP TO 250 FT IN HEIGHT.

the friction in inches of water is read along the top of the chart. The curves indicate the diameters of the stacks and the arrows indicate the point where the friction loss becomes 0.20 in. It must be remembered that these charts represent losses for 100-ft. stacks and that the loss for any other height can be obtained by multiplying by the desired height and then pointing off two places.

For stacks at sea level the above information is sufficient, but stacks at higher elevations must have their diameters increased as shown by the percentage in the right-hand column in Table V. The volume—owing to the lower atmospheric pressure—is increased at higher elevations, as shown in Table V, the volume at sea level being taken as a base. This shows that a correction factor is necessary for stacks at higher elevations. The additional height for any elevation can be obtained from the "theoretical draft" chart (Fig. 1), but the diameter must be increased until the enlarged *area* exceeds the original area computed by the *same* percentage, as the volume of the air at the given elevation exceeds that at sea level. Thus, at 10,000 ft. above sea level, the volume of the air per pound being 51% greater, the area of the stack (not the diameter) should be enlarged 51% in order to maintain the same velocity as would be experienced under similar conditions at sea level.

For example, suppose a steel stack, lined, at sea level is to be designed to serve

Six—250 H.P. boilers with four of

TABLE V—FACTORS OF AIR AT VARIOUS ELEVATIONS

ELEVATIONS FT. ABOVE SEA LEVEL	AIR PRESSURE LBS. PER SQ. IN.	CUBIC FEET PER LB.	INCREASE IN VOLUME %
0	14.7	13.33	0.000
1,000	14.2	13.80	0.034
2,000	13.7	14.31	0.073
3,000	13.2	14.84	0.113
4,000	12.7	15.43	0.158
5,000	12.2	16.07	0.203
6,000	11.7	16.75	0.257
8,000	10.7	18.31	0.373
10,000	9.7	20.20	0.514

them in service at 50% overload in extreme weather or six in service at normal rating.

Coal to be burned, bituminous run of mine;

Breeching, steel, 75 ft. long—square—
Turns, one—90° up from boiler,
one—90° into the breeching,
one—90° towards stack and
one—90° up into stack.

Turning to Table III and assuming 5 lbs. of coal per horsepower it is found in the columns under the heading "Pounds of Coal per Boiler H.P." and in the column under the heading "5" that 1,500 B.H.P. will require 7,500 lbs. of coal per hour (in the extreme left-hand column) and that the "Pounds of Air per Second" (in the extreme right-hand column) is 38.

If each boiler has 80 sq. ft. of grate surface, with six boilers in service, the total grate surface would be 6 × 80 sq. ft., or 480 sq. ft., but with only four in service the total grate surface would be only 4 × 80 sq. ft., or 320 sq. ft.

7,500 lbs. of coal/320 = 24 lbs. per sq. ft. at 150% rating.

7,500 lbs. of coal/480 = 16 lbs. per sq. ft. at 100% rating.

In Table IV it is found that the fire loss for run of mine bituminous coal at 24 lbs. per square foot is 0.14 in. and, for 16 lbs. per square foot, 0.08 in. and

The boiler loss may be assumed at 0.25 in. at full rating or 0.40 in. at 150%.

Smoke breeching loss totals:

0.1 × 75/100 = 0.075 for straight pipe

Four bends @ 0.05 = 0.20 for bends, or 0.28 in. total for bends and breeching.

Assumed for stack 0.2 in. per 100 ft. of height

The total draft loss is then equal at

	100% Rating, Inches Water	150% Rating Inches Water
Fire	0.08	0.14
Boiler	0.25	0.40
Breeching	0.28	0.28
Stack	0.20	0.20
Contingencies	0.10	0.10
	0.91	1.12

From Fig. 5 the curve at sea level shows that the stack (for 100% rating) must be about 103 ft. high, increasing its friction loss to 0.2 in. × 103/100 = 0.21 in. making 0.92 total, requiring possibly 103 ft. actual height. As the

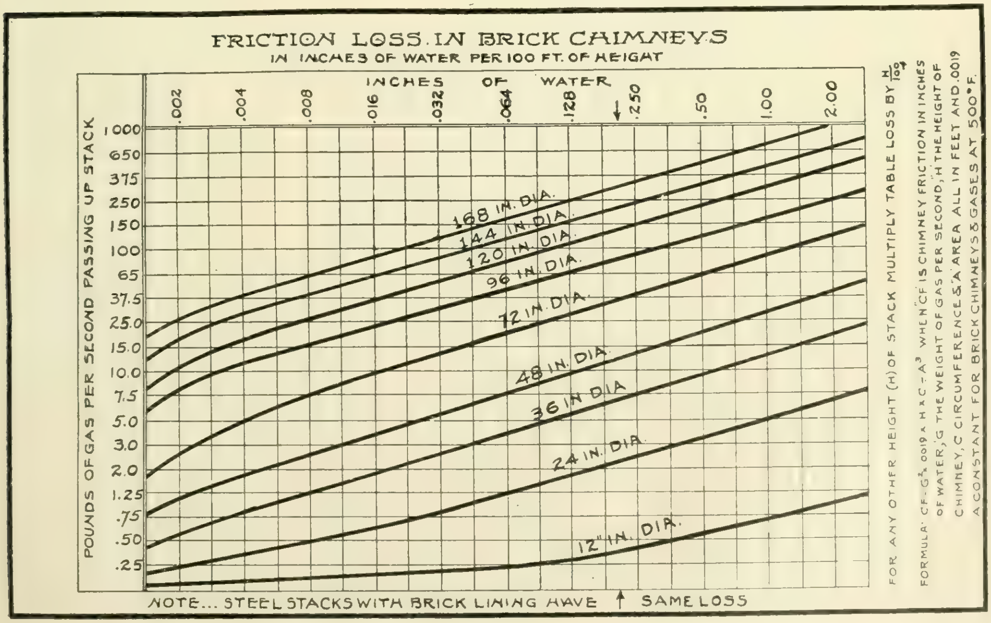


FIG. 6—DRAFT LOSSES IN BRICK STACKS OR LINED STEEL STACKS 100 FT. HIGH.

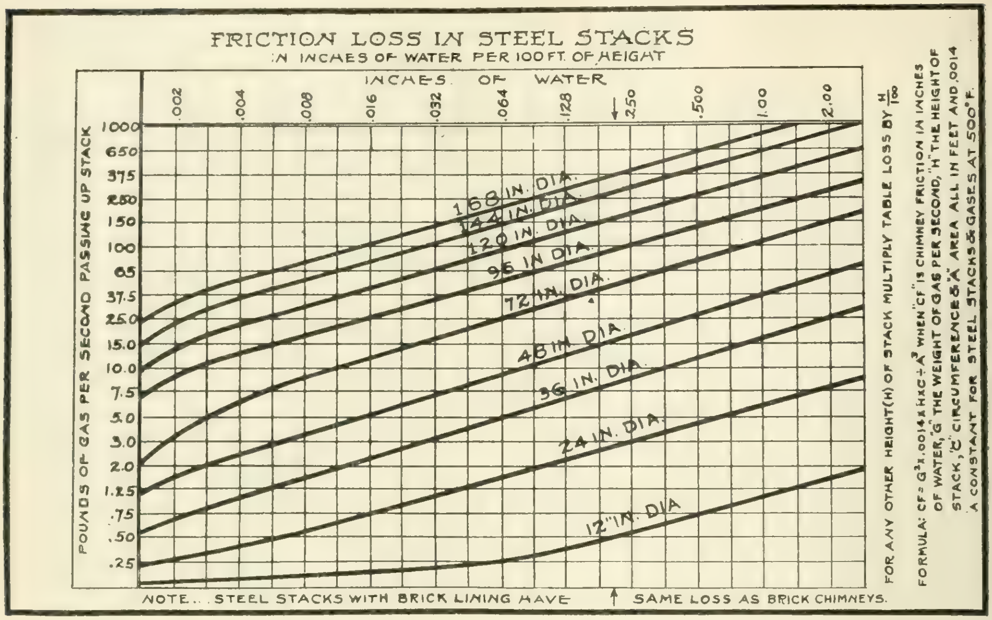


FIG. 7—DRAFT LOSSES IN UNLINED STEEL STACKS 100 FT. HIGH.

stack is lined the friction loss will be the same as a brick chimney and in Fig. 6 the point under the arrow and opposite 38 lbs. of air per second is found to be almost on the 72 in. line, this diameter of stack being correct for the 100% rating.

For 150% rating by similar procedure the required height of stack is found in Fig. 5 to be 127 ft. and the friction loss will be 0.2 × 127/100 = 0.25 or 1.17 in., total, or about 130 ft. height required, Since under these conditions the chimney friction loss is 0.25 in. by referring to Fig. 6—opposite 38 lbs. of air per second and under 0.25 in. loss, the intersection falls on 72 in. diameter exactly. This shows that the diameter is the same in each case because, of course, the quantity of gas is the same, but the height must be increased when forcing the four boilers to 150% of their ratings.

Now suppose this stack was to be located at a point 5,000 ft. above sea level. Then the theoretical draft must be 1.12 in. as before, but, referring to Fig. 5, it is found that for 5,000 ft. requires a stack 158 ft. high. The friction loss is then 0.2 × 158/100 = 0.31 in. and this will increase the total friction by 0.31 — 0.2, or 0.11 in., making 1.12 + 0.11 = 1.23 in. This applied to Fig. 5 shows a stack actually required 172 ft. in height.

Then with a stack friction of 0.31 in. of water, in Fig. 6 under 0.31 in. and opposite 38 lbs. of gas per second is found a point close to the 72 in. diameter line. Reference to Table V shows that the volume at 5,000 ft. is increased 20%. The area of a 72-in. stack is about 28 sq. ft. which, increased by 20%, is 28 + 28 × 0.2,, or 33 sq. ft., or about a 78-in. stack.

To summarize—Add all friction losses together (fire, boiler, breeching, turns, etc.) allow 0.2 in. for stack friction and obtain total theoretical draft. Read height of stack for these losses from Fig. 5 and modify stack loss of 0.2 in. to suit height of stack found. Re-read new and final height from this modified figure. Read diameter for volume of gas per second and height found from Figs. 6 and 7. If stack is above sea level read height from proper curve in Fig. 5 and increase area according to Table V.

CHIMNEY COSTS.

As far as the cost of chimneys is concerned this is a rather variable amount and depends on the material of construction, the foundation necessary, location of job, etc. The ordinary materials of construction are common red brick, radial brick, steel and concrete. Steel stacks are divided into lined and unlined or partially lined and also into self supporting and guyed stacks. Steel is the most unstable of the materials mentioned, these stacks lasting 10 to 12 years and requiring frequent painting; they rust rapidly when not in service. Lined steel stacks have a lining of fire brick to protect them from the action and heat of the gases contained.

Brick stacks last a long time, while concrete is practically indestructible if properly erected. Radial brick chimneys are built of special radial brick which have five or six holes about 1 in. in diameter running through them vertically.

The cost of radial brick chimneys per horsepower will run about as follows for the maximum horsepower which they will handle:

Up to 100 ft. high 4 ft. to 6 ft. dia., $2.50 to $4.50 per H.P.

Up to 125 ft. high 6 ft. to 12 ft. dia., $2.30 to $3.75 per H.P.

Up to 150 ft. high 8 ft. to 14 ft. dia., $1.75 to $2.75 per H.P.

Up to 175 ft. high 10 ft. to 14 ft. dia., $1.75 to $2.00 per H.P.

Up to 200 ft. high 12 ft. or over dia., $2.00 per H.P.

If the cost of a radial brick stack be taken as unity the comparative costs of other constructions will vary about as follows:

	Cost per Horsepower
Radial Brick	1.00
Common Red Brick	1.25
Steel—self supporting—lined	1.23
Steel—self supporting—partially lined	1.14
Steel—self supporting—unlined	.86
Steel—guyed, lined	1.00
Steel—guyed, partially lined	.80
Steel—guyed, unlined	.60

This same method of sizing stacks may also be used for power boilers if properly modified. For instance, maximum power loads may and will come when the temperature is 90° F., instead of zero; therefore theoretical draft must be computed with allowance for this condition. The writer knows that 62° F. is the common outside temperature assumed in calculations for power chimneys, but why? What will be done with a maximum load on a hot day—say at 90°?

Economizers if used will not only build up the friction loss about 0.3 in. in addition to all other losses, but will also cool the stack gases down to 250° to 300°. This must also be allowed for in computing theoretical draft.

When stokers are used with forced draft all fire losses may be eliminated, as in this case the duty of the chimney will extend only so far as to pull the gases off from over the fire bed. It is best, however, to figure about 0.1 in. over the fire to prevent back drafts when the firing doors are opened and the forced draft may be blowing through some open spots in the fire.

A Study of Ventilation with Screened Windows.

Supt. Wm. G. Cleaver of Bethlehem, Pa., in his annual report to the board, has given a brief summary of a study of ventilation by the gravity method and by the use of cloth window screens. The study covered a period of five months, from November to April, and was limited to six rooms distributed among three buildings. In each of the buildings one of the rooms was equipped with cloth screens and the other, of the same grade, with the usual means of ventilation.

In making the study, careful records were kept covering temperature, nutrition as shown by weight, health as denoted by absences due to minor ills, resistance to diseases of graver character, and mental condition as indicated by results of a series of speed tests designed to reveal fatigue. The results bear out the following conclusions:

Temperature—No trouble was experienced in maintaining the temperature of all the rooms at approximately 70° F.

Ventilation and Atmosphere—The air did not recirculate as freely in the rooms with screened windows as in those ventilated in the usual manner. During the latter part of the school sessions the air in the first-named rooms became unpleasant and oppressive.

In general, the conclusion is reached that the method of ventilating with cloth screens does not possess advantages which justify its general use.—From the *American School Board Journal.*

The Importance of Personal Supervision for Heating Departments of Utility Companies

Why a Heating Superintendent is Essential in Effecting Economies and Increasing the Revenue.

By R. V. STUREMAN,
Superintendent Heating Department, Springfield (Ill.) Gas & Electric Company.

The central station heating business is comparatively new and is passing through the same development stage that the electric business passed through a few years ago. It has been looked upon as an incidental side issue or a necessary evil in connection with the electric department. For this and various other reasons it has not always been intelligently handled in the past. It is very gratifying to see that this condition is changing—that the managers and executives of utility companies are beginning to realize that the district heating business can be made a profitable one.

HEATING DEPARTMENT SHOULD HAVE ITS OWN SUPERINTENDENT.

Several things are necessary before a heating company can be put on a paying basis. Among these are the personal superintendence and management by one who is interested solely in his own department. So many companies in the past have felt that the heating department could take care of itself and, in the majority of cases, the superintendent of the gas or electric department has had supervision over it. In these cases the superintendent was generally more interested in the larger department and the heating department suffered by receiving practically no attention whatever.

It is high time for those companies which are not at present operating on a profitable basis to meet the conditions squarely and overcome the difficulties in the best way suited to the existing conditions. This would include the adoption of a proper meter rate and the assumption of the burden of education of the consumer by the company to eliminate unnecessary use of steam and the supervision of the consumer's installation to insure his getting a proper system and one which will permit him to get the best service at the least cost, including the practicable convenience for the company to furnish the service. This latter will influence the cost of service by the company and, on that account, the rates to be charged, which in turn have a direct bearing upon the total cost of heat to the consumer.

The supervision of the consumer's piping and heating system is necessary on account of the fact that so many systems are put in by pipe fitters who are pipe fitters only and have not realized their responsibility or intelligently studied or worked out the possibilities of the problem.

To perform this work of supervision of installation and the education of the consumer along the lines of regulation, will require an expert especially trained in the operation of a central station heating plant and one who can devote his entire time and closely associate himself with the people and cope with all the different problems which may arise. He should have absolute supervision of his department from the time the service leaves the station until the bills for service are paid by the consumer.

TYPICAL RESULTS OF CO-OPERATION WITH CONSUMERS.

The importance of the company's co-operating with its customers in the regulation of their service is most forcibly brought out by the recent attempts of two heating companies to change all customers from flat to a straight meter rate. The companies will be referred to by the letters "A" and "B."

During the year 1911, the gas, electric and heating business in the town A was purchased by a well-known utility company. This town has a population of about 10,000 and was similar to other small-town, locally-owned-and-operated plants. Everything was on a flat rate basis and the rate was away below any proper flat rate. The method used to determine what the rates should be on a building was to charge a few dollars in excess of what the coal bill has been before. It can readily be seen that the operation was very careless and that the customers had no thoughts regarding the proper use of steam, the majority hardly knowing that it was possible to shut off the steam supply in their building. During the first year of the new management, the rates were allowed to remain the same.

At the beginning of this year a man was put in charge of the department and every conceivable record was compiled regarding the heating system and consumer's premises. At the end of the season it was decided to adopt a meter rate and cancel all the flat rate contracts. A report was compiled showing what each consumer had paid and showing what they probably might pay under the new meter rate. These figures were placed before each customer and considerable time was spent in talking to them about the use of steam and how they could eliminate the waste which would be so much to their and the company's benefit. This talk and figures gave them an opportunity to know in advance just what they might expect during the coming season. If their flat rate had been exceptionally low and with the best of regulation it would be impossible for them to keep down to that amount, they were told. If they were not satisfied they could discontinue the service if they so desired. They appreciated this frankness on the part of the company and, as a result, out of ninety customers only two refused to sign.

EFFECT AFTER METERS WERE INSTALLED.

During the heating season the operation of the meters was watched very closely by a capable meter man and a record was kept of the consumption for each consumer by weeks. Each week the condensation per square foot of radiation was computed and if the consumption seemed to be excessive, a personal visit was paid the customer by the superintendent and all the conditions existing in connection with his building were carefully analyzed in an effort to find where the excess steam was being used. If the steam was actually being wasted, the consumers were shown so that the waste might be eliminated. In several cases the service piping was found to be trapped and service condensation was being carried over into the customer's meters. In these cases the service was immediately changed. The superintendent kept in touch with all the consumers, talking regulation continually and endeavoring to give them the best service possible. The season ended wonderfully successful, as the comapny's revenues were increased and the station send out materially decreased. The feeling of the people was pleasant and, while several had had their season's bill increased, they appreciated the co-operation they had received from the company. Some were able to see where they could reduce still further the next year, while others realized that under the old basis of charging they had been paying less than they should and were willing to pay the increase because the service received had been so much improved.

Now this pioneer work in education was absolutely necessary. In this town it has been brought up to standard and is now self-sustaining and almost unnecessary. Anyone starting out anew with meter rate has only to be told the mere principles of regulation and he will instinctively save, but it naturally requires considerable thought for anyone to do this who has been on a flat rate for years, using all the steam possible for twenty-four hours a day throughout the entire season.

RESULTS OF CHANGE TO METERS WHERE CONSUMERS WERE NOT CONSULTED.

The results of lack of co-operation is seen in the situation that the town B is facing at present. Town B is very similar to Town A and the size of the systems are practically the same. This plant has been operated on the old basis of rates based on amounts of radiation which, in most cases, had no connection whatever with the building. The heating department in this place was under the supervision of the electric department superintendent.

Last summer it was decided to make the change from flat to meter rate. An outside engineer was called in and data were compiled on the consumer's radiation and a report was made up showing what each had paid and what amount probably would be paid on a meter rate. This report was then turned over to the local men in charge and it was left to them to conduct the work of making the change. Nothing was said to the consumers, but the general impression and idea was given out to all that a meter rate was even cheaper than the flat rates they had been paying which, in most cases, were ridiculously low. Meters were set and steam turned on in the fall. The people had always used steam continuously and they continued to do so. The only difference between meter rate and flat rate to them, as far as steam was concerned, was a different method of computing their bill which should now be less and that they could still use as much steam as ever before.

It was not possible to get all the meters set before the steam was turned on so most of the first month's bills were on the old flat-rate basis. The second month, however, passed by and the meter bills were enormous—in some cases double and even triple the old flat-rate. A strenuous complaint was made regarding the high bills, together with a few complaints as to service. Previously a Paul air-line system had been operated with the pump at the plant. This increased the circulation in the system, giving good service for those systems which were not properly installed. After the change in rate this air line was abandoned, which resulted in poor service for those customers. With a small amount of investigation and expense these troubles could largely have been remedied, greatly to the people's satisfaction, which would have recompensed them in part for the increase in their bills. Nothing was done and the third month went by. The bills this time were still higher. Some in these three months had paid more than before in an entire season. Headed by an attorney eager for a following and prominence, a complaint was filed with the State Public Utilities Commission and a rate case is now in progress which is being a tremendous expense to the company.

EXPENSE OF A HEATING SUPERINTENDENT MORE THAN MADE UP BY ECONOMIES EFFECTED.

On first thought the expense of a superintendent for the heating department might seem prohibitive to many small companies but I will cite the experience of a large holding company owning and operating electric, gas, railway and heating properties in several States. Eight of the plants maintain heating systems, which range in size from 900,000 sq. ft. to about 50,000 sq. ft. of radiation connected.

Four years ago only one of these plants had a superintendent for the heating department. All of the plants but this were a losing proposition. From the results being obtained in this city it was decided to install a heating expert to have general supervision of all the heating departments of the various properties. The man chosen for this position was the one who had been superintendent of the above mentioned plant. During the past four years under his direction a superintendent has been placed in charge of the heating departments of each company and instead of the expense being higher, in each and every case there has been a material decrease by their personal supervision and the revenue has increased.

The record of one plant in particular is worthy of mention. During the spring of 1916 a man was put in charge of the heating department whose sole duty was the management of that department. During the past year he has made a saving in the operating expense and the revenue has increased over $8,000.00. One of the main reasons for the increase in revenue is the complete repairing and testing of the condensation meters. Also, previously, the registration of the meters were not given much attention. A consumer's bill was adjusted on the basis of the same month's bill in a previous year, the company not analyzing the steam consumption nor making any effort to receive payment for the amount of steam used if it seemed at all excessive.

All of these companies now possess a complete system of records from which it is possible to know definitely just how the plant is operating. The financial condition of these plants is changing so that the prospect is exceedingly bright for them to soon become profit-making concerns, rather than losing ones.

To my mind the importance of personal supervision for heating departments is of paramount importance above any other single item in the successful operation of a central station heating company.

The Transmission of Steam in a Central Heating System

How Extra "Feeder" Lines From the Boiler Plant Were Used to Solve the Problem of Overload.

By J. H. WALKER.

(*Presented at the annual meeting of the American Society of Heating and Ventilating Engineers, in New York, January* 16-18, 1917.)

The central heating situation in Detroit is, in many respects, unique. The rapid development of the business district and the popularity of the heating service have resulted in the extension of the distribution system over a very wide area, and the connecting of new buildings has made the street pipe system entirely inadequate for the transmission of the quantities of steam now required.

The problem thus arising has been met by treating the general network of pipes as distributing mains, and resorting to the use of "feeder" lines which extend from the boiler plants to the centers of load and which are used solely for transmitting steam to the distribution mains proper, no consumers being served from these feeders. The method which has been developed is parallel to that used in electrical distribution, where feeders radiating from the generating station carry current, with a large voltage drop, to various points in the net-work of mains. In the working out of this method, much attention has been given, perforce, to the matter of transmitting large quantities of steam over long distances in an economical manner.

DETERMINING MOST ECONOMICAL PIPE SIZES.

The problem is essentially one of choosing the pipe sizes so as to keep the investment costs and radiation loss at a minimum. There are four factors entering into the selection of pipe sizes: *a.* the amount of steam flowing; *b.* the length of the pipe; *c.* the pressure drop, and *d.* the size of the pipe. The first two quantities are fixed by the given conditions. Since the size of the pipe governs the investment required, it is desirable to use a small pipe and allow a large pressure drop when exhaust steam is used, the available pressure drop is the difference between the back pressure allowable on the electric generating units and the minimum pressure required at the end of the line. The difference is usually quite small and the resulting pipe sizes are consequently comparatively large; although it is now possible to buy turbines which will carry their rated load at a back pressure of 25 lbs., allowing the use of much smaller pipes. The use of bleeder type turbines also permits higher pressures on the steam lines at the plant, with a consequently larger available pressure drop.

In most central heating systems some live steam is used, either to augment the available exhaust during the coldest weather or to supply the system entirely. In feeding live steam directly to the system, the conditions are quite different. The upper limit of the pressure gradient which can be established in the line is then the boiler pressure of the plant, and under maximum load conditions the full drop from boiler pressure to distribution pressure may be made to take place in the steam line instead of in a reducing valve. The diameter of the pipe which is required under these conditions is relatively very small. It is only recently that the full possibilities in this direction seem to have been realized and put into practice.

Suppose, for example, that it is desired to transmit 12,000 lbs. of steam per hour over a distance of 1,000 ft., with a terminal pressure of 10 lbs. If the pressure were reduced at the plant and the pipe designed for the ordinary velocities of 8,000 to 10,000 ft. per minute, an 8-in. pipe would be required. If, however, the usual standard of velocity is disregarded and the full available pressure drop from boiler pressure (assumed as 125 lbs.) to 10 lbs. is allowed in the pipe line, a 4-in. pipe would be sufficient. The cost of an 8-in. underground pipe 1,000 ft. long would be about $6,000.00. The cost of a 4-in. pipe of the same length would be about $4,000.00, 33 1-3% less. The heat loss per square foot of pipe surface would be greater in the case of the small pipe because of the higher average temperature of the steam in the pipe, but because of the less surface of the small pipe, the total heat loss would be less. It should be borne in mind, however, that in nearly all cases the heat loss is a small factor compared with the investment charges.

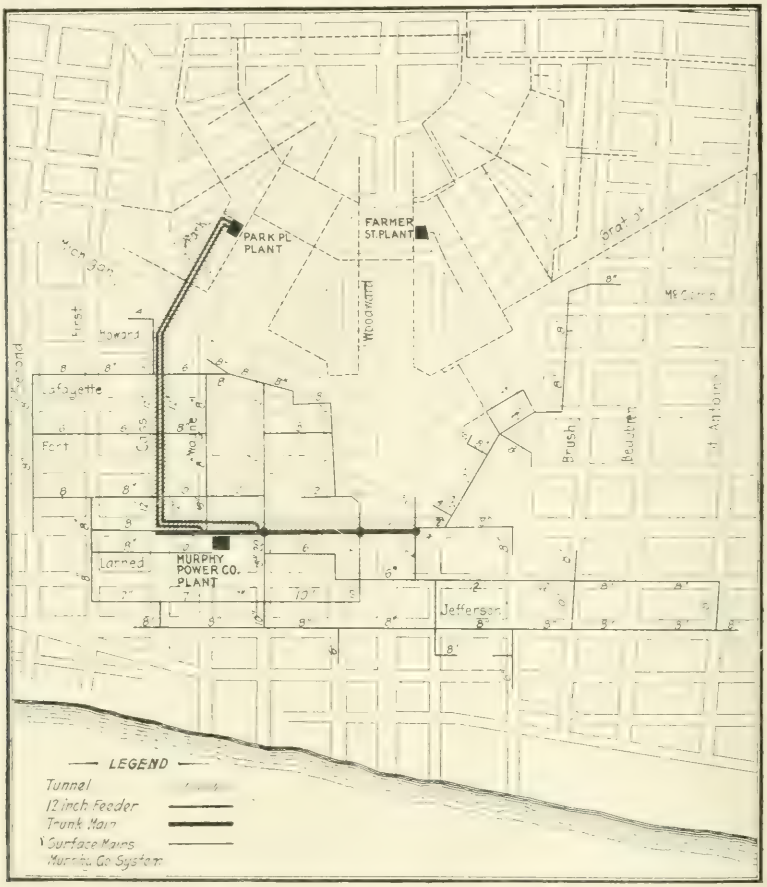


FIG. 1—TRUNK MAIN AND FEEDERS TO MURPHY POWER COMPANY HEATING SYSTEM, DETROIT.

PRESSURE REDUCTION NECESSARY ON DISTRIBUTING MAINS.

In most of the existing central heating systems, it is impracticable to carry pressures approaching boiler pressure on the distribution mains. Even if the underground construction is not of the low-pressure type, considerations of safety would require elaborate pressure reduction equipment in the consumers' buildings. Therefore, when the maximum allowable distribution pressure has been reached on the mains, where they are fed only at the plant, it becomes advisable to run out from the plant "feeders" of small diameter, carrying steam at high velocities, and with large pressure drops, to remote points in the distribution system. The pressure of the steam delivered to these feeders can be varied as the load requires, in order to maintain a constant pressure at the point where they tie into the distribution system. Such live steam feeders can also be advantageously applied to exhaust steam systems in which the limit of back pressure has been reached. Where this condition exists, the available exhaust is usually inadequate in extreme weather, and such live steam as is added should be fed into the system at some distant point through a high velocity feeder instead of being fed in at the plant and thereby further raising the back pressure on the engines. A third case in which such feeders can be used occurs when local conditions require that the boiler plant be located at some distance from the center of the load. Some interesting examples of this method of transmitting live steam have recently been worked out in Detroit, where the central heating system is operated by The Detroit Edison Company.

TYPICAL INSTALLATIONS OF "FEEDER" LINES.

In 1914, the heating system of the Murphy Power Company, serving about 500,000 sq. ft. of radiation in the business district, was taken over by the Edison Company. Since the Murphy Company's boiler plant was not taken over with the system, it became necessary to feed the system from the Park Place plant of the Edison Company, located about 2,000 ft. away. This plant supplies live steam to the Edison Company's heating system, and the addition of new boilers rendered it capable of handling the increased load.

At this time it was found advisable to replace the trunk distributing main of the Murphy system with a new main, and a new tunnel was constructed directly beneath the old, and about 45 ft. below grade, in which was installed a new 20-in. trunk main with 18-in. risers connecting with the surface mains. From the Park Place plant, a connecting tunnel was constructed, in which were installed two 12-in. "feeders," tying into the trunk main at the two chief centers of distribution, as shown in Fig. 1. Fig. 2 is a cross-section of the tunnel containing the trunk main, the two feeders, a condensation return line, and a high-pressure main which supplies steam for cooking and laundry purposes. This trunk tunnel is 8 ft. high and 8 ft. wide, and the feeder tunnel is 6 ft. high and 6 ft. wide. Both are built of three rings of brick, with concrete floors.

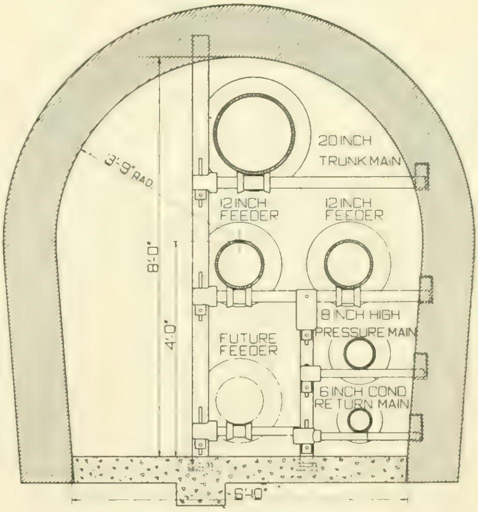


FIG. 2—CROSS-SECTION OF TUNNEL SHOWING TRUNK MAIN AND "FEEDERS."

The Murphy Company's system had been originally designed to operate at nearly atmospheric pressure and the underground mains were of low-pressure construction. The new piping was therefore arranged with the idea of carrying a low pressure on the trunk main and varying the pressure on the 12-in. feeders at the plant as required, in order to maintain a constant pressure on the trunk main. The feeders are built with extra heavy fittings and with joints of the "Crane-lap" pattern. The connection of one of the feeders with the trunk main is shown in Figs. 3 and 4. The diameter of the feeder is gradually increased by means of the special taper fittings, in order to reduce the velocity of the steam before it makes the abrupt turn into the trunk main.

IMPORTANCE OF LONG-DISTANCE PRESSURE RECORDERS.

The success of such an arrangement as this is entirely dependent upon the possibility of having at the plant a reliable and continuous indication of the pressure existing at the remote end of the feeders. This requirement has been successfully met by the use of the recently-developed electrical long-distance recording gauge. This instrument comprises a transmitter located at the point at which the pressure is to be measured, and a recorder, similar in appearance to the ordinary recording instrument, located on the gauge board at the plant. Single phase alternating current at 110 volts is used to operate the instrument. In the transmitter the deflection of an ordinary pressure spring moves a pivoted armature. A similar armature in the recorder is magnetically constrained to move an equal distance, thereby deflecting the pen arm proportionately. The instrument is illustrated in Fig. 5. Aside from some trouble caused by the extreme conditions of heat and moisture under which the transmitters must operate, the instruments have proven quite satisfactory.

At the end of each of the feeders a transmitter is installed (see Fig. 4) and the recorders are located at the Park Place plant. The pressure on the trunk main is maintained at about 6 lbs. at all times. The load is ordinarily divided about equally between the two feeders and the pressure on the feeders at the plant is varied from 10 to 50 lbs. in actual practice. In moderate weather only one feeder is used. Fig. 6 shows a typical chart from one of the long distance gauges. The heavy black lines are drawn at the 5 and 7 lb. marks and the plant engineers are instructed to keep the pressure within these limits. With a pressure at the plant of 50 lbs., the load on each feeder is about 115,000 lbs. of steam per hour, with a velocity of 16,000 ft. per minute near the plant and 54,000 ft. per minute at the point where the feeder ties into the trunk main. On a few occasions a load as high as 155,000 lbs. per hour has been carried on one feeder, giving the very high velocity of 75,000 ft. per minute near the point where the feeder ties into the trunk main. This velocity is decreased to 27,000 ft. per minute in the taper fittings illustrated in Fig. 3. Under these conditions the steam is superheated about 60° F., due to the drop in pressure.

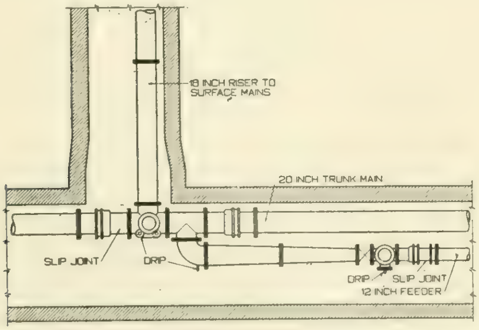


FIG. 3—CONNECTION OF ONE OF THE FEEDERS TO THE TRUNK MAIN.

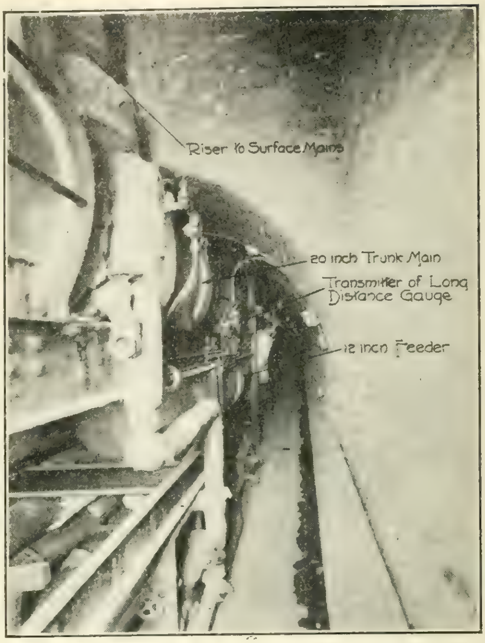


FIG. 4—VIEW IN TRUNK TUNNEL AT POINT OF CONNECTION OF FEEDERS TO TRUNK MAIN.

While there is, of course, a considerable amount of noise from the pipes, there is no excessive vibration and there seems to be no reason why the feeders could not be worked to their full capacity if necessary; that is, with boiler pressure on them at the plant.

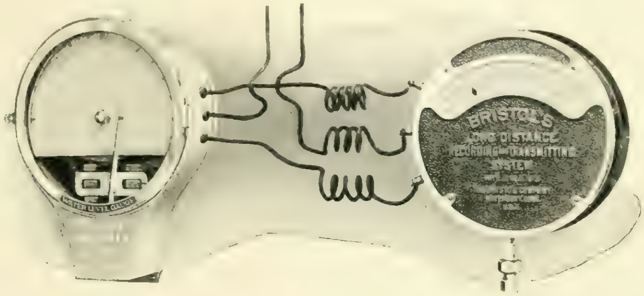


FIG. 5—THE LONG DISTANCE ELECTRIC PRESSURE RECORDING GAUGE.

Four feeders have since been installed in other parts of the Edison Company's heating system, operating on the same principle. They are shown in Fig. 7. Feeders A, B and C feed into a portion of the system upon which a pressure of 30 lbs. is maintained. Each is provided with a long-distance gauge and the pressure carried on them at the plant varies from 35 to 80 lbs. Feeder C is in a tunnel and, in addition to the long distance gauge, a hydrostatic pressure line is brought back to the plant, serving as a check on the long-distance gauge. Feeder D was installed to supply live steam to the lower end of the upper portion of the system, which is operated at exhaust steam pressures. The presseure on the 18-in. trunk main had been raised to the safe working limit and the installation of this 12-in. pipe obviated the necessity of enlarging the trunk main. None of these feeders are loaded up to full capacity, as they were designed to take care of future requirements of the system, which is growing at the rate of about 230,000 sq. ft. of radiation per year.

Besides allowing the use of small pipes, it is evident that this method of feeding steam places the control of the pressures throughout the system in the hands of the plant engineers and tends to increase the liability of the service to the consumer—a factor of increasing importance.

TEST RESULTS CHECKED WITH UNWIN FORMULA.

During the winter of 1915-1916, some tests were made on one of the 12-in. Murphy feeders with a view to checking the actual capacity of the pipe against the figures computed from the well known formula of Unwin:

$$P = \frac{0.0001306\, W^2\, L\, \left(1 + \frac{3.6}{d}\right)}{y\, d^5}$$

P = Drop in pressure, lbs. per sq. in.
W = Weight of steam flowing, lbs. per minute.
L = Length of pipe, ft.
d = Diameter of pipe, in.
y = Mean density of steam, lbs. per cu. ft.

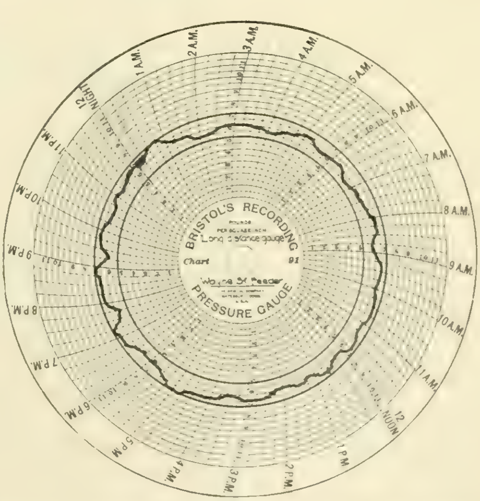


FIG. 6—TYPICAL CHART FROM ONE OF THE LONG-DISTANCE GAUGES.

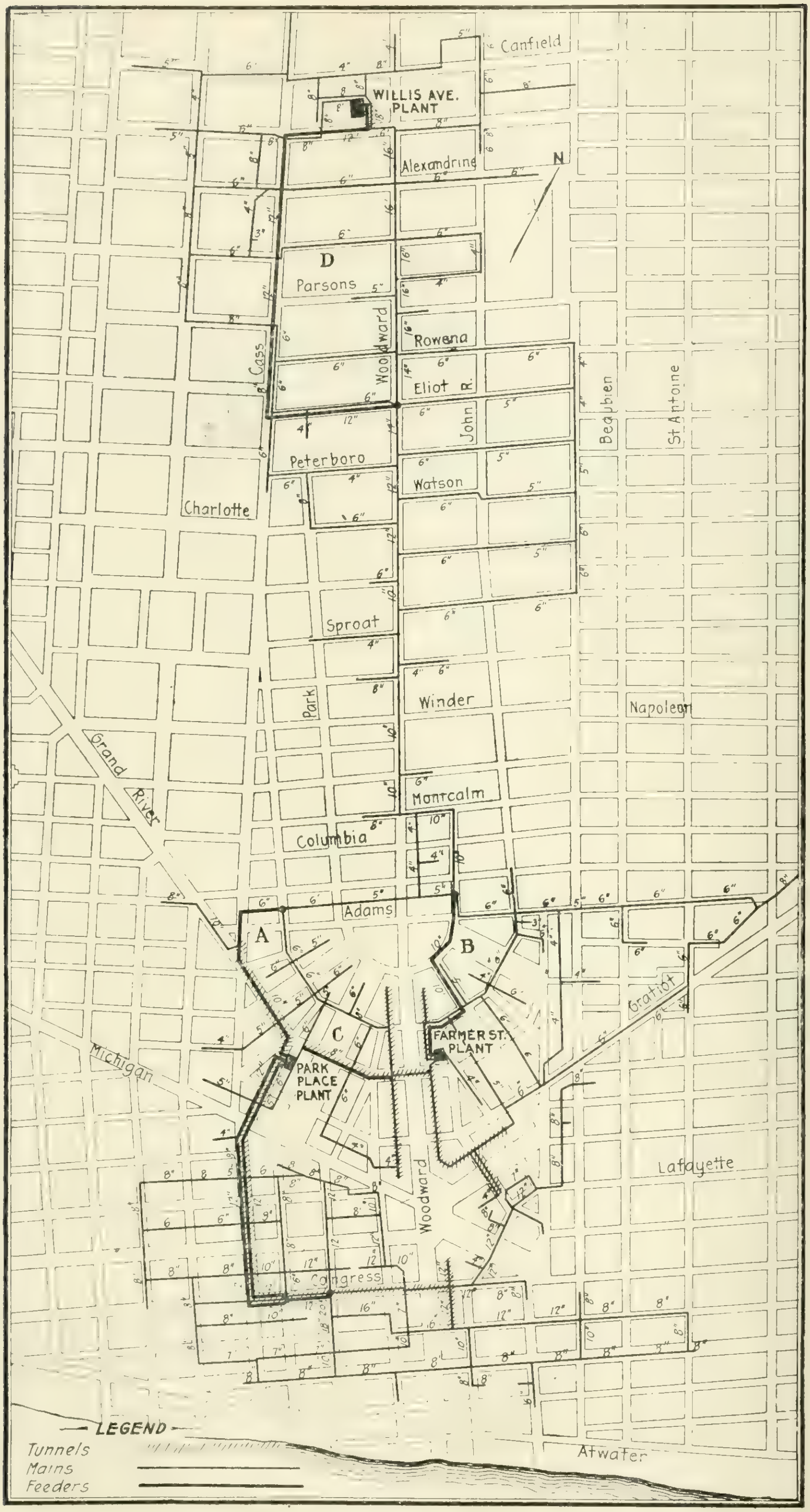


FIG. 7—MAP SHOWING THE FOUR FEEDERS SUPPLYING DIFFERENT SECTIONS OF THE DETROIT EDISON COMPANY'S HEATING SYSTEM.

The steam flow through the pipe was measured with a General Electric Company flow meter of the RS-2 type, equipped with a pressure compensating device. This meter was checked several times during the tests with a meter of the TS-3, or visible mercury column type, attached to the same pitot tube. The pressure at four points along the 1900 ft. length of pipe was measured with open mercury columns. The connections to these mercury columns were taken either from the drip connections or from openings tapped into the pipe wall. The steam temperature was observed at two points with mercury thermometers immersed in mercury wells which were inserted into the 12-in. pipe. Readings were taken on all of the instruments at the same instant, at a signal given by flashing the lights in the tunnel. The amount of steam flowing was varied by steps and several readings were taken at each step. The steam was in a superheated condition at all points in the pipe. The drop in pressure along the pipe for various quantities of steam flowing is illustrated graphically in Fig. 8.

The values for *W*, the steam flow, were computed by means of the Unwin formula, from the pressure drop through each section of the pipe. A comparison of these computed results with the actual steam flow as read from the steam flow meter showed surprising results, the computed quantities being much less than the actual observed quantities. In Fig. 9, the ratios of the actual to the computed steam flow are shown graphically. These points represent the results of about seventy-five sets of readings taken during three separate tests. It will be noted that the results for the successive sections of the pipe for each quantity of steam flowing are in fairly close agreement, especially at the higher rates of flow where the pressure drops were larger and the effect of the errors of observation were consequently reduced. The tests are not of sufficient scope to warrant an attempt at revising the formula, but they certainly indicate the necessity for further research.

◆

New Book.

COMBUSTION IN THE FUEL BED OF HAND-FIRED FURNACES is the title of Technical

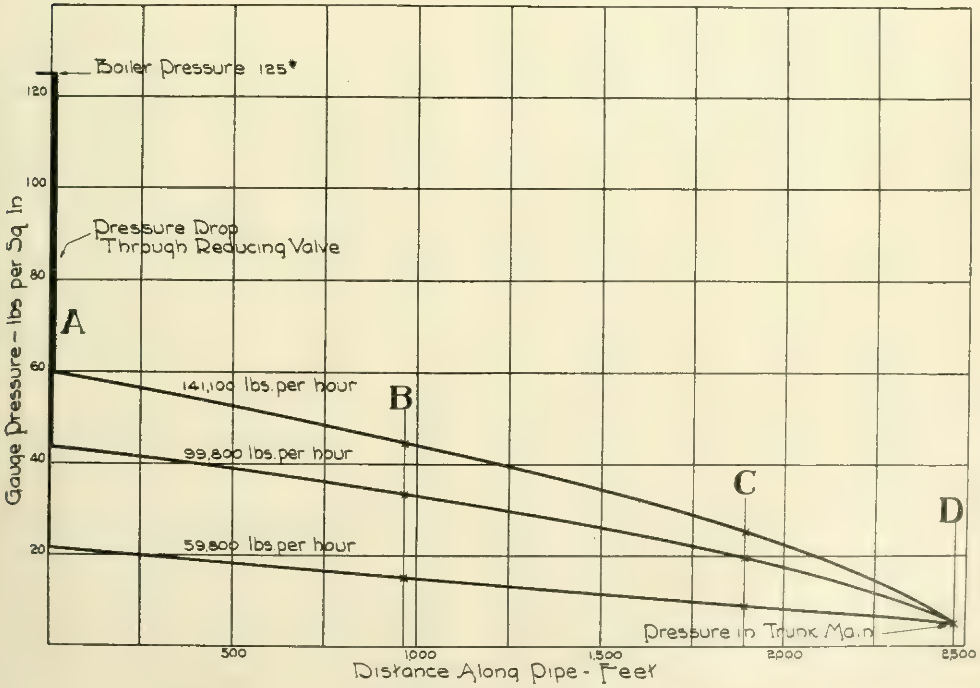


FIG. 8—PRESSURE DROP IN 12-IN. FEEDER FOR VARIOUS LOADS.

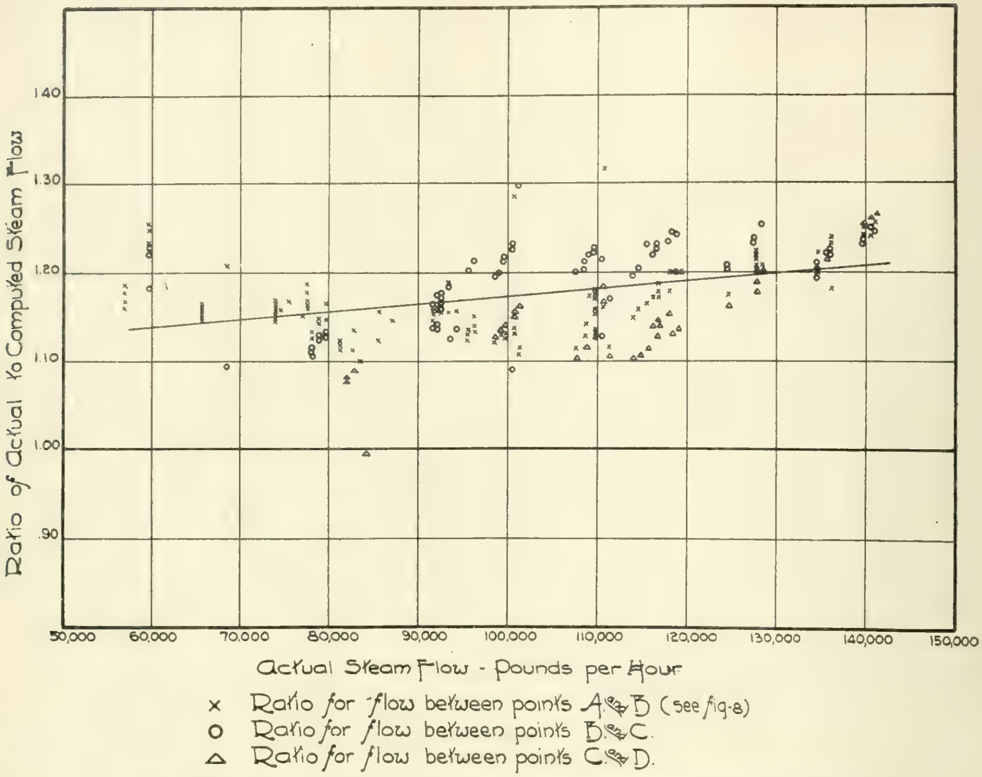


FIG. 9—RATIOS OF THE ACTUAL TO THE COMPUTED RATES OF STEAM FLOW.

Paper 137, by Henry Kreisinger and others, which has just been issued by the Bureau of Mines of the Department of the Interior. The main object of the investigation was to determine the conditions governing the process of combustion in the fuel bed of a hand-fired furnace. The results of this investigation furnish data for correct design of coal-burning grates and furnaces and their efficient operation. They also cast light on the important problem of clinker trouble as related to fusibility of ash, and indicate the possibility of a high rate of gasification of coal in gas producers. The first part contains general information on the combustion of coal in furnaces. What combustion is and how the process of combustion takes place is explained, also how much air is needed to burn one pound of coal and how the air and the coal are brought together to effect combustion. The method of feeding coal and air in four types of commercial furnaces is shown and discussed. The second part contains the description and the results of about fifty tests made in a small experimental hand-fired furnace, which was designed for an accurate study of the processes of combustion in the fuel bed.

The third part discusses the investigation described in the second part of the report, and includes about forty charts that show the composition of the gases and the temperature at different depths in the fuel bed of a hand-fired furnace, and various relations between the air supply and the rate of combustion.

The fourth part contains miscellaneous data on the composition of gases rising from the fuel bed of a hand-fired furnace under a steam boiler, a Murphy stoker, and a Jones underfeed stoker. Copies of this technical paper may be obtained free of charge by addressing the Director of the Bureau of Mines, Washington, D. C.

SOME MODERN METHODS OF VENTILATION, with special reference to public buildings, and including standards of ventilation, design of ducts, selection of fans, washers and heaters, specifications, test forms and specimen schedules for designers, is the title of a new book, written by R. Grierson, a well-known English mechanical and heating engineer. The book was first published in England two years ago and is now gotten out in an American edition. It is designed as a comprehensive treatment of the subject of ventilation, starting out with the general principles of ventilation, the apparatus employed, ducts and registers, fans, etc. The chapter on considerations to be observed in the design of the air circuit is an interesting presentation of the laws regarding velocity variations. A mathematical presentation is also made of the relation between velocity and pressure head. In the chapter on heaters, several English types are shown, together with the well-known Vento type and some comparisons are made, especially with reference to the full data published on Vento heaters and the English method of rating such apparatus in "length of 4-in. pipe, and then complain of foreign competition." A chapter is also included on ozone, accompanied by an English type of ozone machine.

Throughout the book generous mention is made of American apparatus, especially in connection with temperature-controlling devices. Methods for making tests of ventilating apparatus are given in detail, the book concluding with "suggested schedules for designing" and a typical set of specifications. Size 5½ x 8½ in. Pp. 187, with 37 illustrations and 40 tables. Price $3.00. Published by the D. Van Nostrand Co., New York, or may be had through the book department of THE HEATING AND VENTILATING MAGAZINE.

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The Inventor of the Ross Valve.

The death of George Ross, founder of The Ross Valve Manufacturing Company, and the inventor of the Ross valve, which occurred February 9, at his residence in Troy, N. Y., marks the passing of a man who had a typical American career and who achieved a substantial measure of success.

Mr. Ross was a native of Scotland and lived to the ripe old age of 87 years. He came to this country in 1851, having previously learned the trade of carpenter and pattern-maker. During the Civil War Mr. Ross was engaged in the manufacture of gun carriages in the Watervliet Arsenal, where he became noted for his mechanical skill.

About 1878 Mr. Ross obtained his first patents on the Ross valve. Soon after he started the business of the Ross Valve Manufacturing Company. The principal user of the Ross Valve was the United States Government, but the valve became known and was sold all over the world. Although noted as a high-pressure valve it could be regulated at low pressure and it came into use on some of the largest water systems in the country. Despite the fact that the plant was not operated on a very large scale, the reputation of the valve became widespread due to the quality of workmanship initiated and maintained by Mr. Ross.

Mr. Ross's three sons, John C. Ross, Adam C. Ross, 2nd; and William Ross, will continue to operate the business, as they have done since the retirement of their father some years ago.

◆

Suggestions for Auxiliary Gas House-Heating.

A correspondent of *Gas Institute News* writes: "I heat my house with hot water American radiator equipment. Tens of thousands of others do the same. We have public service gas supply. Why have not you gas people evolved some appliance that we can stick into our fire pots and do away with coal? An enormous outlet for the gas industry, yet seemingly unrealized. Coal $8.50 per ton.

"I have read with interest scientific treatise on the subject. What would be even more interesting would be the plain record of John Jones, first with his coal hot-water heater buring coal one whole winter, then the same heater equipped with gas one whole winter."

In replying to the correspondent the following was contributed by C. C. Winterstein, chairman of the house heating committee of the American Gas Institute:

"In direct contradiction to what apparently is the correspondent's belief in the matter, this injiury touches upon a subject that is one of the most mooted and liveliest questions in the gas industry today. This subject is still in its infancy, but it is being quite thoroughly investigated, and as many available data as can be obtained are being compiled with a view towards the determination of certain fundamental facts concerning the subject from its practical side.

"To the best of my knowledge, the mere installation of burners in the fire-box of a coal heater does not result in a very commendable gas house heater, due to the fact that the heat absorbing elements of the coal appliance do not adapt themselves favorably to the obtainment of a high efficiency when used with gas. Other changes would be necessary to increase the efficiency of the converted coal heater, the nature of these changes being largely dependent on the particular conditions surrounding each individual installation. It would seem that the best course to follow would be to provide a suitable auxiliary gas equipment, which would supplement the coal appliance and could be used during the mild seasons.

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IF a proposed new law designed to govern the practice of architecture, which has recently been proposed in California, should be enacted, it would look as if the ranks of the heating and ventilating engineers in that State would be swelled by a body of men to be known as "structural engineers." The proposed law, which has been introduced in the State legislature as Assembly Bill No. 1126, starts out by providing that plans for all new buildings, except residences, and all alteration work which affects the strength and safety of the buildings, must be prepared by a person holding a certificate from the State Board of Architecture, and further provides that this board shall grant two kinds of certificates, one to "design and superintend the erection of buildings," and the other as "architect." Applicants must undergo examinations in order to procure either kind of certificate.

An applicant for a certificate "to design and superintend the construction of buildings" shall be examined as to (*a*) his practical experience, technical knowledge of materials, their strength and use in practical construction, his ability to compute mathematically the strength and stresses in materials and structures, and ability to design a building or structure so as to insure inherent stability and strength in all its parts and to meet the contingencies and problems of construction and public safety that arise in the erection of buildings; (*b*) theoretical and practical knowledge of sanitation as applied to buildings, and his ability to design plumbing systems; (*c*) knowledge of the theory and design of heating and ventilating systems, and his practical understanding of the various systems in use; (*d*) his knowledge of stereotomy; (*e*) his knowledge of specification work; (*f*) his general education and knowledge of architectural terms, together with his character and fitness for a certificate.

The holder of either certificate will be entitled to prepare plans and superintend the erection of buildings of every kind. Persons securing a certificate as "architect" will be entitled to use the word "architect" as designating their profession and to advertise as such, but it is made unlawful for any one else to use the word "architect" or any derivation in any way which might result in designating such person as an architect. Persons holding a certificate "to design and superintend the erection of buildings" will be entitled to use the words "structural engineer" to designate their profession.

The proposed law further provides that it shall be unlawful to construct, erect, alter, add to, repair or reconstruct any building, if the work affects the strength and safety of the building, except residences, unless plans for the work are prepared by and the work done under the supervision of a person holding a certificate "to design and superintend the erection of buildings" or as "architect."

Re-Establishment of Temperature Control on a Central Station Hot Water Heating Plant.

The Peru Heating Company, in Peru, Ind., installed its central heating plant during the summer of 1902. In this plant the Powers system of temperature control was used. This type of control gave uniform satisfaction so long as the air lines could be maintained. In the instance of Peru, however, the air lines failed after being in service some eleven or twelve years.

Several methods have since been tried to re-establish the temperature control as it was at once recognized that the usual method of charge for hot water heat, namely, the square foot basis, demanded that some means of control on the service must be employed.

The devices tried were not without merit, but the engineers were always confronted with the fact that all or a part of the old control would have to be abandoned unless some control could be devised that would salvage the valves and thermostats. This was accomplished by converting the Powers compressed air thermostat into an electric thermostat by attaching little contacts on the face of the same, without disturbing the thermostatic element or adjustment in any way.

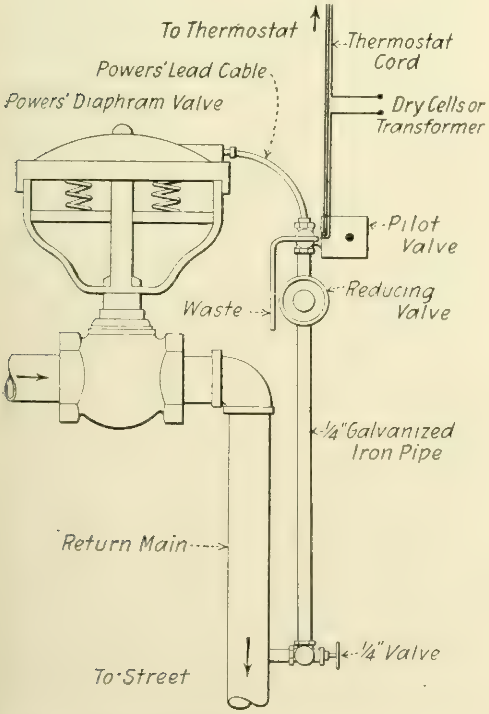

FIG. 1—ARRANGEMENT OF PILOT VALVE IN CONNECTION WITH MAIN POWERS DIAPHRAGM VALVE FOR RE-ESTABLISHING TEMPERATURE CONTROL.

Fig. 1 shows the general scheme of installing the pilot valve in connection with the main Powers diaphragm valve in the basement. It will be noted that where test cocks are installed it is not necessary to cut into the line; in fact, the conversion is usually made without closing off the service. Moreover, all of the old equipment is re-employed, except some armored lead cable, which is replaced by a three-wire thermostat cord.

The water for operating the diaphragm valve is taken from the return line through a small Powers reducing valve, if the pressure is excessive for the diaphragms. The amount of water required is represented by the number of operations of the valves and is very slight. The pilot valve is of the magnetic type and is operated, through dry cells or bell ringer transformer, by the thermostat, and simply permits water to pass to the diaphragm or from it thus shutting off the service or opening it as the thermostat may demand.

In this connection it is interesting to note that there are about 100 control outfits on this plant, most of which have been installed 15 years and in every case the old rubber diaphragms on the valves, as well as the thermostats themselves, were found in such good condition that no repairs have been found necessary, even though a considerable part of the apparatus went through the flood four years ago.

The re-establishment of the temperature control at Peru is in line with the accepted policy of "equal service" to all the consumers and when completed will place the plant on an operating basis regulated by temperature and pressure charts, as well as by the pumpage records, coal consumption curves, CO_2 records, stack temperatures and stack drafts.

The change in temperature control was devised by J. C. Hornung, of Chicago.

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Electric and Steam Service in Hotels, Department Stores and Office Buildings.

If grandfather could come back in his prime to-day, in place of the "old inn" or "tavern," with its candle light in the window to guide the traveler to the doorstep, he would see, when yet many blocks away, the mammoth electric sign of the modern hotel. Upon arriving he would register and would be whirled toward the roof by central station service, to a room lighted and heated by central station service. He would take a bath in water heated by central station service, would don clean linen laundered by central station service, would go down to a dinner cooked with central station service, drink a glass of water cooled by central station service, and enjoy his repast in an atmosphere of washed air tempered by central station service. The same is true of the modern department store and office building, although somewhat modified in degree of service. — *W. P. Whittington, of the Springfield (Ill.) Light, Heat & Power Company, before the New Business Co-Operation Committee, Cincinnati, O.*

◆

Maximum Temperature in Which a Workman Can Work.

What is the maximum temperature in which a workman can work without undue discomfort or injury to his health? This question was asked recently by a correspondent of *Safety Engineering.*

The inquiry was referred to Frederick L. Hoffman, Statistician of the Prudential Insurance Company of America and the following views are the result of his investigation of this important subject:

Mr. Hoffman bases his reply on the assumption that the question is limited to the qualification as to the extreme heat possible in a drying room in which heated air is used and in which workmen are required to handle materials. Perhaps a typical illustration, he says, would be the drying room of a linoleum works in which practically all the moisture is extracted from the atmosphere and in which, as a consequence, acrolein is developed, which is considered more or less injurious to health. Thus, extreme heat and extreme dryness may be complicated by chemical factors, even more injurious than dry heat itself. Of course, extreme heat coincides with extreme atmospheric dryness which, as such, is injurious to health. It is usually considered that a relative humidity of less than 30% is injurious to the human organism.

The second question is the degree of continuous exposure. Mere heat exposure, especially radiant heat in front of furnaces, even though over 2,000° F., is not seriously injurious, in that it is rapidly disseminated and felt at most only by the front surface of the body for a very short period of time. Such heat exposure obviously does not require consideration in answer to the question.

The third factor, and perhaps the most important, is bodily exertion under extreme heat, accompanied by extreme dryness. Such bodily exposure is much less trying under extreme dry heat than under extreme degrees of atmospheric moisture accompanied by relatively high, but not abnormal, temperatures.

According to the most recent treatise on "The Diseases of Occupation" by Kober and Hanson, "exposure to dry heat for a short period is sometimes borne without serious effects in temperatures as high as 140° or 150° F., provided the air is kept in motion." This condition, of course, is radically different from excessive temperature exposure on the part of puddlers and electric furnacemen, who, for a very brief period, may be exposed to temperatures of 212° F., etc., without serious injury. Mr. Hoffman states that he is inclined to think that a radiating temperature may very materially exceed this figure without serious bodily injury, even though burns may be caused, which usually are of less consequence. It is said in the work referred to that "prolonged exposure, however, is usually followed by grave constitutional disturbances; these need not to be gone into." It is also said that "the men engaged in handling molten metal and all others exposed to radiant heat not infrequently suffer from dermatitis, an inflammatory condition of the eyes, and even cataract, induced by the partial dehydration." This, in fact, is perhaps the most serious effect of extreme heat endured for a short period of time, but at frequent intervals.

The most scientific treatise on the subject is an address on "The Effects of Exposure to Intense Heat on the Working Organism" by Surgeon Charles N. Fiske of the United States Navy, published in the Transactions of the fifteenth International Congress on Hygiene and Demography. Most of the observations have reference to heat affections in the navy, but they may possibly be more applicable to the question than information derived from other occupational experience. Referring to the temperature of the berth accommodation on the *Marblehead,* which was from 90° to 92° F., it is said that this heat rendered it almost impossible to obtain refreshing rest. The fire room, however, had a temperature as high as 140° and it is said by Dr. Fiske that he, himself, had observed a temperature as high as 186°, but that the average was 120° and in the engine-room from 105° to 110°. Under these conditions, however, work was considered endurable and no very serious cases of illness were experienced.

On submarines, under conditions of active service, equally high temperatures, if not higher, have been endured without fatal results. One of the best authorities on this subject is Prof. Frederic S. Lee of Columbia University. He directs particular attention to the importance of air movement as separate and distinct from mere heat and humidity. He remarks: "In proportion, however, as the temperature of the air approaches or surpasses that of the body and the humidity of the air is sufficient to prevent the evaporation of sweat, loss of bodily heat by the customary channels becomes lessened. Without adequate means for eliminating the heat that is being constantly produced within, the internal temperature rises and a febrile condition results. Such a state is reached the sooner the more mechanical work is performed and the more heat is thereby produced. Its oncoming is favored also by a lack of movement in the air. With a continuance of the unfavorable environmental conditions a simple rise of internal temperature may pass into a higher fever characteristic of simple heat prostration, or a moderately severe heat stroke with a temperature up to 40.6° C. (105° F.), and finally into the hyperpyrexial or intense form of heat stroke, in which the bodily temperature has been known to rise to the phenomenal height of 47.6° C. (117.8° F.)."

Mr. Hoffman is of the opinion that the best practical information can be obtained from those in charge of linoleum works. Certainly in his own experience the temperature conditions there were the most trying of which he has knowledge. They do not compare with, but are in contrast to the excessive heat experienced in the lower levels of the Comstock Lode. A comparison really is difficult, if not impossible, for totally different bodily effects are experienced. In the Comstock Lode the air suffers also chemical contamination, as is the case in the drying-rooms of linoleum works.

In his investigations at steel plants, Mr. Hoffman states that he does not recall excessive temperatures much over 120° F., as far as actually determined. The enormous heat inside the furnace may be over 2,000°, but it dissipates so rapidly in the general atmosphere that, as shown by the government report on labor conditions in the iron and steel industry, it rarely, if ever, exceeds 147° F., which was ascertained 12 ft. away from the tap-hole of a furnace. Such a heat, of course, does not affect the body as a whole, which can only be said to be the case in a close compartment, such as the drying room of a linoleum plant or the engine room of a submarine.

It is stated by Dr. W. Gilman Thompson that the oil mixture in linseed manufacture is heated to approximately 450° F., during which progress certain fumes are evolved. This temperature, however, has no reference to the heat conditions in the drying-room. In linseed oil manufacture the substance is mashed and pressed to a temperature of 125°, but whether the men are exposed to this heat for a sufficient length of time to be injuriously affected, is not made clear by the available discussion. It is said that the workmen are protected from the excessive heat by drafts of compressed air.

According to an investigation by Mr. Hoffman, made some years ago, the temperature in drying chambers at linoleum plants may be raised as high as 180° F., but this temperature may possibly not prevail when the rooms permit ingress and egress on the part of the workmen, while placing in or taking out rolls of linoleum. Of course, the time exposure on the part of these men is relatively short and it should not be understood that the work as such is seriously injurious or exactly proportionate to the degree of temperature exposure for a very limited period of time. The effects of sudden and radical temperature changes may, in the long run, be more seriously injurious to health than short-time exposures to high temperature, even though the latter are experienced at frequent intervals over comparatively long periods of time. This, however, is debatable.

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Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

HOT WATER

Hot Water Heating. Ills. 1,500 w. Prac. Eng., Chi.—Jan. 1, 1917. Systems employed and their connections. 60c.

HOTEL PLANT

Power Plant of Hotel Traymore. Walter C. Edge. Ills. 2,000 w. Nat. Engr.—Jan., 1917. Equipment. 20c.

INDUSTRIAL PLANTS

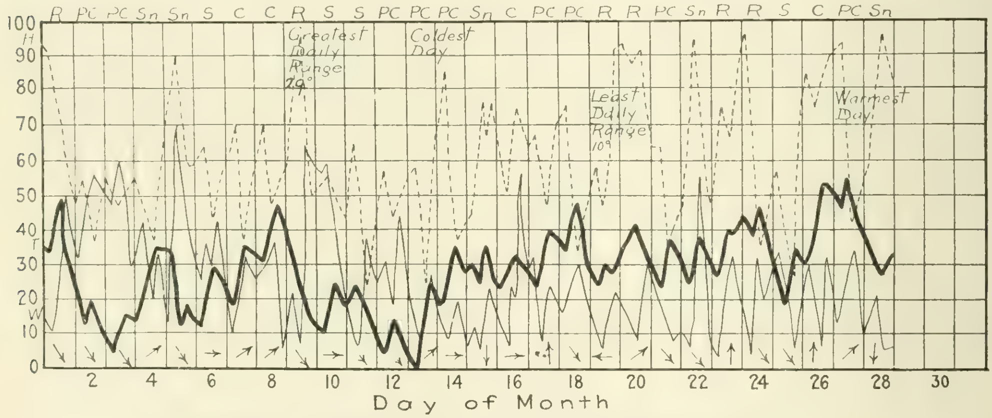
The Heating of Machine Shops. Ills. 1,200 w. Cas. Eng. Mthly.—Dec., 1916. Methods. 40c.

VIBRATION

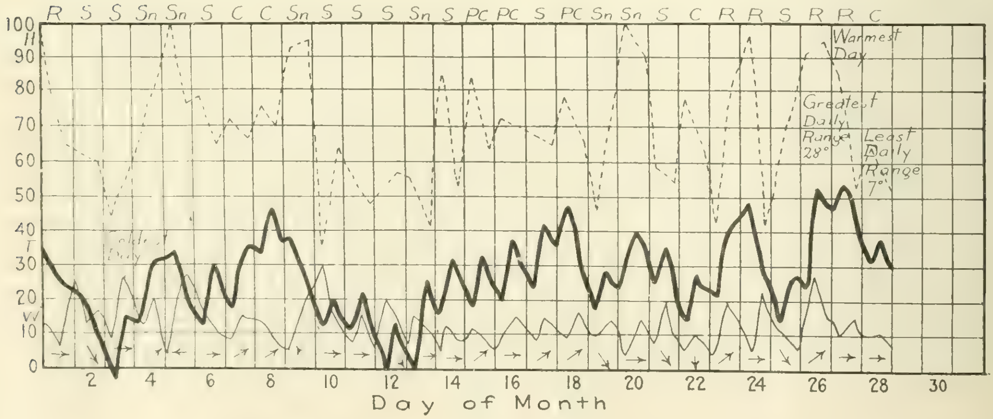
The Prevention of Vibration in an Apartment House. Ills. 1,200 w. Power—Jan. 2, 1917. Trouble overcome by changes in piping and installing shock and sound arresters. 20c.

The Weather for February, 1917

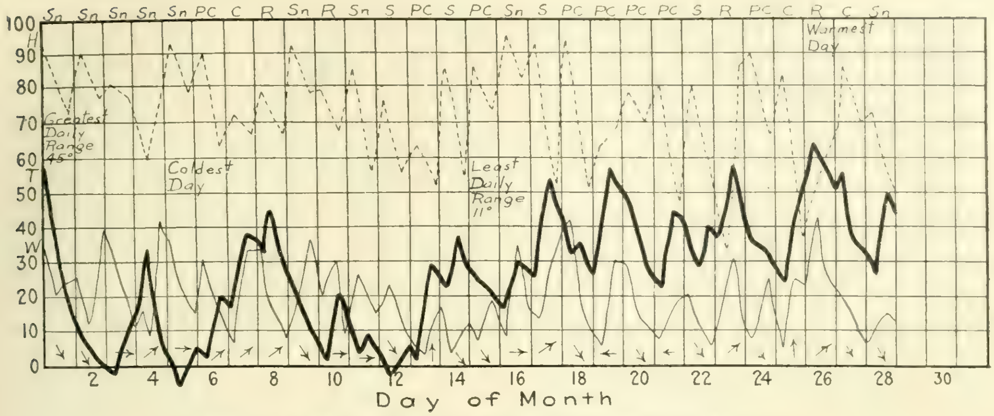
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	55	53	64	50	68
Date of highest temperature	27	27	26	25	25
Lowest temperature, degrees F.	0	—3	—6	—10	—10
Date of lowest temperature	13	3	5	2	2
Greatest daily range, degrees F.	29	28	45	30	39
Date of greatest daily range	9	26	1	22	4
Least daily range, degrees F.	10	7	11	5	7
Date of least daily range	19	28	15	18	18
Mean temperature for month, deg. F.	28	26	27	19.8	30.4
Normal Mean Temp. for month, deg. F	30.7	28	31.8	25.4	33.5
Total rainfall, inches	1.70	2.67	0.99	0.67	0.35
Total snowfall, inches	12.2	8.4	3.4	4.5	1
Normal precipitation, this month, in.	3.87	3.56	2.66	2.16	2.75
Total wind movement, miles	13965	8045	9564	9498	10023
Prevailing direction of wind	N.W.	W.	N.W.	N.W.	N.W.
Average hourly wind velocity, miles	20.8	12	14.2	15.6	14.9
Number of clear days	4	12	5	10	7
Number of partly cloudy days	14	8	12	10	10
Number of cloudy days	10	8	11	8	11
Number of days on which rain fell	11	11	10	8	4
Number of days on which snow fell	5	6	9	5	1
Snow on ground at end of month, in.	3.6	None	Trace	None	None



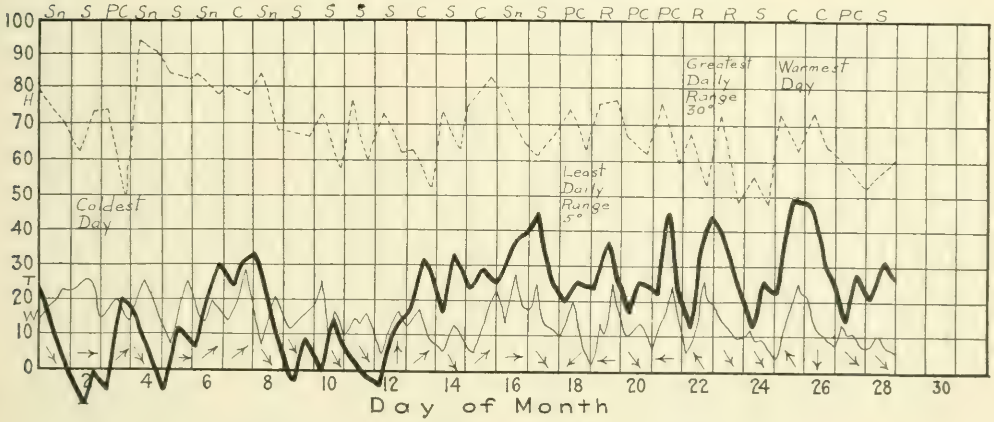
RECORD OF THE WEATHER IN NEW YORK FOR FEBRUARY, 1917.
(Hourly Observations of the Relative Humidity are Recorded on this Chart.)



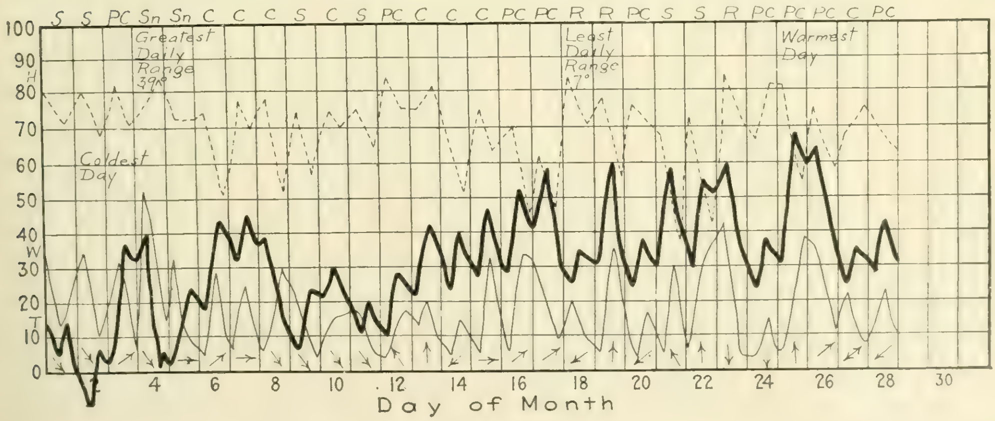
RECORD OF THE WEATHER IN BOSTON FOR FEBRUARY, 1917.



RECORD OF THE WEATHER IN PITTSBURGH FOR FEBRUARY, 1917.



RECORD OF THE WEATHER IN CHICAGO FOR FEBRUARY, 1917.



RECORD OF THE WEATHER IN ST. LOUIS FOR FEBRUARY, 1917.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Dates Selected for Society's Summer Meeting.

Announcement is made that the forthcoming summer meeting of The American Society of Heating and Ventilating Engineers will be held in Chicago, July 18, 19 and 20. These dates fall on Wednesday, Thursday and Friday.

It is expected that one of the papers to be presented at the summer meeting will be an elaboration of the address delivered at the March meeting of the Illinois Chapter on the hot water heating system at the plant of the Crane Company and plans are being made to take the delegates in a body for an inspection of this plant.

Heating Engineers' Society in New Quarters.

New quarters for the American Society of Heating and Ventilating Engineers have been taken in the Engineering Societies Building. The new offices are on the same floor as formerly but in a larger room—Room 712.

Volume 22 of the society's Proceedings, covering the transactions for the annual and summer meetings of 1916 has been sent out. It is a volume of 595 pages. In addition to the verbal discussions of the various papers and topics, are a number of written discussions which add materially to the value of the Proceedings.

Appointment of Committees on Boiler Code and Research.

President J. Irvine Lyle of the American Society of Heating and Ventilating Engineers has appointed two committees which are expected to accomplish important work for the society during the next year. One is a committee to formulate a standard code for the testing of low pressure heating boilers. This committee consists of Homer Addams, chairman; Prof. John R. Allen, J. J. Blackmore, Ralph Collamore, William H. Driscoll, Walter L. Fleisher, Louis A. Harding, James F. McIntyre, Edwin A. May, Percival H. Seward and Walter S. Timmis.

The other committee will investigate the matter of the establishment of a bureau of research, to be conducted under the auspices of the society. The personnel of this committee is as follows: George W. Barr, chairman; Harry M. Hart, Prof. James D. Hoffman, William F. McDonald, William W. Macon, James W. H. Myrick and Perry West.

Ventilation of Submarines Discussed by New York Chapter.

Practical and vital problems encountered in the ventilation of submarines and how the Navy Department is meeting them were presented at the March meeting of the New York Chapter, March 19, by Lieutenant E. D. McWhorter, U.S.N. The meeting was held at the Building Trades Club, with President Arthur Ritter in the chair. It was in charge of a committee headed by D. D. Kimball.

The fact that many of the chapter members had witnessed the submarine manouvers at New London last November added greatly to the interest in Lieutenant McWhorter's address, which was illustrated by lantern slides.

In opening his address Lieutenant McWhorter stated that he was after information rather than in a position to give it. He said the principal problem in the ventilation of submarines was in connection with storage battery ventilation. The electric batteries give off hydrogen gas in excessive quantities and this has to be taken care of to prevent dangerous accumulations. Then it is necessary to ventilate the electric motors when running submerged and also to remove the oil vapors that accumulate in the operation of the oil-fired Diesel engines. All of the foregoing is in addition to the general ventilation requirements for the ship's personnel. For the latter purpose a compartment of 150 cu. ft. area is provided in which compressed air is stored at a pressure of 2,250 lbs. per cubic inch. For general ventilation purposes, when running on the surface, there are usually two 600-cu. ft. supply blowers driving air through ducts to the various points of the hold and two exhaust blowers of the same capacity exhausting the air outboard.

The new types of submarines, said Lieutenant McWhorter, can easily go from 24 to 36 hours submerged, without resorting to any chemical means of renewing the air supply. By the use of such chemical means it is possible to stay submerged as long as ten days.

The danger of hydrogen gas explosions is the important item as this gas becomes an explosive at a concentration of 3½% or 4%. For this reason it is necessary to have a separate ventilating system for the battery cells. On the surface this system exhausts outboard but when submerged the gas is carried to another part of the vessel and mixed with the other air and recirculated. Regarding the oil vapors, the same procedure is followed except that the oil vapors can be expelled from the vessel when running submerged. If in the vicinity of enemy vessels, however, this would leave a streak of oily water that would betray the vessel's presence. Another reason for separating the ventilation of the engine room from that of the motors is that the oil vapors have a tendency to rot the insulation.

Regarding the air supply to the men themselves the speaker said that their allowance was 35 cu. ft. per hour and that it was a common experience to have the carbon dioxide run up to 200 parts in 10,000. Whenever the air got particularly bad or the heat excessive, electric fans were started that helped greatly to relieve the men.

In response to questions Lieutenant McWhorter said that the interior temperatures in submarines ran from 40° to 120° F. Submarines are very cold in winter and are particularly hot in summer.

He said a great many suggestions for improving conditions in submarines or adding to the facilities are thrown out on account of the lack of space available or the weight of the extra appliances. The submarine itself has to be very substantially built as the water pressure at a depth of 200 ft., for instance, is 89.7 lbs. per square inch. He said it was a mistake to suppose that the air pressure inside the submarines increases when deeply submerged as the hull of the vessel takes up all the pressure of the water. The principal effect on the part of the men of any extended submergence is that they usually experience a sleepy feeling on coming to the surface.

In the discussion of his address it was suggested that it might be possible to dispose of the excess hydrogen by combining it with oxygen and by means of a high tension electric current transforming the mixture into water. Lieutenant McWhorter said that this might be a good suggestion to work on, but it must be remembered that such an apparatus must be capable of handling 200 cu. ft. of hydrogen per minute and space would have to be found on the vessel for such apparatus.

On motion of Frank K. Chew three cheers were given for Lieutenant McWhorter for his interest in coming before the chapter and on the suggestion of William H. McKiever, the chapter will present the lieutenant with a suitable souvenir.

It was announced that the May meeting of the chapter, which will be the annual meeting, will be given over to "The Ventilation of Battleships." M. W. Franklin is the chairman of the committee in charge of the May meeting.

Crane Company's Hot Water Heating Plant Described Before Illinois Chapter.

"Hot Water Heating Under Forced Circulation, as Installed in the Crane Plant," was the subject of an illustrated address presented by S. H. McCreary, of the Crane Company, at the March meeting of the Illinois Chapter, March 12. The talk followed a chapter dinner at the Chicago Engineers' Club.

The speaker was introduced by President F. W. Powers. Mr. McCreary stated that the total cost of the new Crane Company plant would approximate $10,000,000 of which $1,000,000 would represent the cost of the heating equipment. The entire plant comprises 50 buildings covering an area of 50 acres and the company has an additional 160 acres adjoining its plant for possible future extensions.

No less than 300,000 sq. ft. of heating surface are now in service, arranged on six circuits in tunnel systems, aggregating a total length of 4,978 ft. The heating system contains 5,332 gal. of water and Mr. McCreary stated that the average drop in temperature of the water in making the circuit of the system is 16°. He stated that one day during the past winter, when the temperature outdoors was 10° F. below zero, the outgoing temperature of the water was 187° and the incoming temperature, 152°, giving a drop of 35°.

At the conclusion of Mr. McCreary's address and upon his request, President Powers gave a description of the system of temperature control installed in connection with the heating plant.

The large attendance at the meeting resulted in a lively discussion on the merits of hot water and steam heating, which was participated in by George Mehring, Robert A. Widdicombe, August Kehm, J. C. Hornung, Harry M. Hart, Dr. E. Vernon Hill, J. F. Tuttle and George H. Kirk.

Michigan Chapter Elects New Officers.

New officers were elected as follows at the annual meeting of the Michigan Chapter, which was held at the Fellowcraft Club, Detroit, February 23: President, Ralph Collamore; vice-president, J. R. McColl; treasurer, Harry A. Hamlin; secretary, William F. McDonald; board of governors. E. E. Harris, J. H. Walker and Thurlow E. Coon. The secretary's report showed the total membership of the society to be 76.

The March meeting, held March 19, was addressed by E. E. Harris, formerly chief engineer for Albert Kahn, architect, but recently associated with the Pittelkow Heating & Engineering Co., who described the heating and ventilation of the Ford Motor Company's factory. Mr. Harris was identified with this work so that he was able to give an intimate description of the installation. This was followed by a lengthy discussion in which many of the 58 members and guests present participated.

The April meeting will be held April 28, when J. R. McColl will present a paper on "The Fundamental Principles of Ventilation."

March Meeting of Kansas City Chapter.

Herbert W. Whitten was elected president of the Kansas City Chapter at its March meeting, to fill the vacancy caused by the resignation of Professor James M. Kent. Professor Kent was unable to serve on account of the press of other duties. R. F. Taylor was elected to the council to fill Mr. Whitten's place.

Following routine business which included the adoption of by-laws, the chapter took up for discussion the paper by Professor G. L. Larsen of the University of Wisconsin, on "The Recirculation of Washed Air in Buildings," which was first presented at the society's 1916 annual meeting. It was the consensus of opinion that while there could be no argument regarding the fuel saving accomplished by the recirculation of air, the chapter would not endorse the recirculation of washed air in school buildings for general practice.

The April meeting was scheduled for April 6, the subject being "Boilers and Smoke Prevention." A series of moving pictures by the Kewanee Boiler Company was to be shown in connection with the presentation of the subject.

It was announced that the chapter is in good shape, with approximately 30 members on the roll.

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Alumni of New York School of Heating and Ventilation Hold Annual Dinner.

An attendance of over 150 guests and a corresponding degree of enthusiasm marked the fifth annual dinner of the Alumni Association of the New York Heating and Ventilating School, which was held at the Building Trades Club, New York, March 12. The outpouring of young men who have been taking the course of lectures given by Charles A. Fuller, during the past few years, was prophetic of the part they are going to play in the future of the heating profession, and their status as embryo users and specifiers of heating apparatus was further evidenced by the presence of many manufacturers, some of whom were frankly bent on "looking over the youngsters."

It was natural to make a comparison between this and the more technical organizations, such as the various chapters of the heating engineers' society. Many commented on the delightful informality of the alumni association's dinner and the comparative freedom from responsibility that characterized its proceedings. The whole affair, however, seemed to indicate that a new medium has been developed which really supplements the work of the strictly engineering organizations. Certainly it would be hard to find a more hearty spirit of good fellowship prevailing than that observed on the part of the alumni association and its guests.

After partaking of a dinner in which the various dishes were the subject of local hits, the speakers were introduced by E. A. Kingsley, who acted as toastmaster. The speakers included Frank K. Chew, Charles A. Fuller, Jack Armour and M. W. Franklin. These were followed by a representative of the first year class, Walter Klocksin; a representative of the second year class, R. A. Wolff; and a representative of the alumni association, M. J. Sage. Before and during the dinner music was rendered by Schmidt's orchestra.

Mr. Fuller said one of the most notable features about the school was the fact that several manufacturers were making it a practice to send their salesmen to the lectures, one firm having sent 12 men to the classes this year. Six firms in all had adopted the practice.

M. W. Franklin emphasized the growing need of heating and ventilating engineering in the industries. In many of the industrial processes, he said, where ventilation was formerly advocated from an altruistic standpoint, it is now recognized as vitally important from the purely practical standpoint of increased efficiency. He then spoke of the rise of chemical engineering and reminded his hearers that most of the processes in chemical engineering depend on the application of heat, so that this field is opening up great opportunities to the heating engineer.

CORRESPONDENCE

Heat Transmitted from Radiators with High and Low Pressure Steam.

EDITOR HEATING AND VENTILATING MAGAZINE:

Will a radiator supplied with high pressure steam give off more heat than when supplied with low pressure steam?

The relative heating effect of a radiator using high and low pressure steam depends largely on the specific heat of the iron in the radiator as it takes far more heat per square foot to raise the temperature of the cast-iron to the working point than it does to replace the heat losses after the iron comes up to a working temperature.

The specific heat of superheated steam changes considerably, but the higher the superheat the less the specific heat. This varies from 0.7 at 200 lbs. saturated to 0.63 at 150 lbs. to 0.57 at 100 lbs. pressure, to 0.51 at 50 lbs. pressure, to 0.47 at atmosphere and to 0.45 at absolute zero pressure.

The specific heat of the steam, it should be noted, has nothing to do with the heat given off by a radiator, provided there is an ample supply at the stated pressure; if the supply is curtailed, the pressure is changed. The only governing factor is the difference in temperature of the room and radiator and the velocity of the air passing over the heating surface.

Where the specific heat of the steam does come in is that it takes a slightly fewer number of pounds of steam to supply a given amount of heat at one pressure than at another, but the amount of heat actually delivered will be according to the difference in temperature of the room and the steam. Naturally, high pressure steam will give more heat, as the temperature is higher.

Condensation on School Room Walls.

EDITOR HEATING AND VENTILATING MAGAZINE:

In a room in one of our schools we had a peculiar condition arise during the very cold weather in February, which I would be thankful to have you explain.

The room in question is in a 12-room brick building and is on the southwest corner of the second floor. It has windows in both the south and west walls. During three or four days, when the outside temperature was down to zero or below, the condensation or sweat formed on the walls and ceiling of this room so heavily that school had to be dismissed. The water ran down the walls in streams and dripped off the ceiling so that the floor looked as if the roof had been leaking all over.

An examination of the attic space over the room showed that the roof was perfectly tight. Furthermore, the plastering of the ceiling itself was perfectly dry. The room is heated by direct radiation under the windows and has no water or steam pipes in the floor, walls or ceiling.

I feel that this condition was undoubtedly brought about by the atmospheric conditions, but the point which puzzles me is why we did not have trouble with any of the other rooms since, as accurately as I could ascertain, the conditions were absolutely the same.

Louisville, Ky.

H.

We do not know of any natural condition of the atmosphere which could be obtained in zero weather that would give the trouble experienced by our correspondent. In fact, the great difficulty in extreme weather consists in raising the humidity indoors to a proper point and we have never known walls or ceilings to sweat at such times. To produce such steaming or sweating two conditions are necessary: first, that the relative humidity of the warm air in the room must approach saturation; and, second, that the cooling surface must be cold enough to cause the air in contact therewith to fall so much in temperature that its point of saturation is passed, causing the excess moisture to be deposited on the nearest surface, which is always the cooling surface.

Glass being a better transmitter of heat than a wall consequently exposes a colder surface to the air in the room and, therefore, the steaming of a window always precedes the sweating of a wall—unless the wall had been standing cold for a long period—in which case it would warm up more slowly than the glass and sweat first. If the glass is sufficiently cold the condensation is frozen and a "frosted" window is the result.

Outside air at zero can carry up to ½ grain of moisture per cubic foot before it begins to precipitate. At 70° F. it can hold 8 grains per cubic foot or 16 times as much. Outside air at zero, however, is never found saturated, its usual "relative humidity" or per cent of saturation being about 50%. Therefore, every cubic foot coming into the building from the outside would carry only ½ grain x 50% or ¼ grain of moisture. This air raised to 70° would still contain ¼ grain of moisture but, since it could carry 8 grains, its per cent of saturization at 70° is ¼ divided by 8 or 0.03 or 3%. Under normal conditions moisture given off in the breath, vaporization of water within the building, steam leaks and so forth may increase this 3% up to as high as 38% to 50% relative humidity which, at the most, is 8 x 50%, or 4 grains per cubic foot.

To cause this air to precipitate its moisture on the wall the air adjacent to the wall must be cooled to a point where it no longer can contain its 4 grains and this temperature would have to be below 50° F. to produce any precipitation at all and quite a way below 50° to produce the amount described.

For this reason we cannot believe that this condition was due to natural causes. Additional evidence that it was a most abnormal condition is furnished by the fact that "we did not have trouble with any of the other rooms—the conditions were absolutely the same."

As to what was the source of this unusual and excessive humidity the correspondent offers no clue except to say that no steam pipes were in the floor, walls, or ceiling. The only suggestion we see indicated is the fact of steam radiators being in the room. High steam pressure—such as would be used in zero weather—might cause the air valves and valve stems to leak excessively and continuously so as to raise the humidity, a cracked radiator section would do the same thing and, if hand operated pet cocks are used for air relief, the opening of these early in the morning could result in the escape of a large amount of vapor which might condense later as described.

Transmission Factors for Combinations of Different Materials.

EDITOR HEATING AND VENTILATING MAGAZINE:

Permit me to congratulate you upon the step you have taken in your endeavor to bring before the heating profession the data to be presented in the "Standard Data Sheets." I trust you will receive the co-operation of the heating experts which this work deserves.

There are two questions on which I would appreciate having your opinion. On sheet No. 1 it is stated that "the combined resistance of the two is then the sum of the resistance of each and the resistance is the reciprocal of the transmission factor." This is in reference to a wall composed of two different materials. Now, if the above statement is true of two different materials, it should also be true of two walls of the same material.

Let us take, for instance, a 24-in. brick wall which transmits 14 B.T.U. per square foot per hour for a difference in temperature of 70° F., and a 12-in. brick wall which transmits 21.7 B.T.U. under the same conditions, the two together making a 36-in. brick wall. By the same process of reasoning, as mentioned on sheet No. 1, $1/14 + 1/21.7 = 35.7 \div 304 = 0.117$, the reciprocal of which is 8.5, which should be the number of B.T.U. transmitted by a 36-in. brick wall under the conditions as above mentioned. You will notice, however, that in the tables on sheet No. 1A the factor for a 36-in. brick wall for these conditions is 11.2 B.T.U. You will also notice that the same inconsistency exists for any other combination of walls of the same materials.

The second question relates to information on sheet No. 1A where you have given values showing that a brick wall plastered on one side will transmit more heat than a plain brick wall. If you apply the same reasoning in this case as mentioned on sheet No. 1, considering a wall of two different materials, you are bound to get a smaller factor for the combination of brick and plaster than you have for plain brick. The factor I have always used for plaster 1-in. thick is 49 B.T.U. per square foot per hour for a difference of 70°. If you are willing to accept this as being somewhere near the correct factor, then the factor for a 12-in. brick wall would be the reciprocal of $1/21.7 + 1/49 = 70.7 \div 1063.3 = 15$.

I trust that you will consider these criticisms as constructive rather than adverse, for I assure you my object is only to help.

P.

Pittsburgh, Pa.

Our correspondent has raised a very interesting question in his inquiry as to why the sum of the resistance factors of a 12-in. and 24-in. brick wall does not equal the resistance factor of a 36-in. brick wall. This is the kind of question we want our readers to ask and we hope for further discussion on the subject by other subscribers if our explanation does not entirely make clear the point in question.

As our correspondent says, we stated that the equation would hold true for two different substances and his reasoning that it should also hold true of two similar substances is quite logical. In the case, however, of two similar substances a *combination* is *not* being made and the *thickness only* is being increased. Now the formula for any thickness of wall with a loss of "X" would be 1/X plus 1/X when the thickness is doubled or 2/X which, changed back to the transmission factor, is X/2 or one-half of the transmission of the original wall. Now this is not true as doubling the thickness of a wall *will not* and *cannot* cut its loss in half. This is easily seen by reference to any table of heat losses.

This is because the loss of heat through a wall takes place in three ways—by leakage, by radiation and by convection. Convection is the heat carried off by the circulation of air against the face of the wall and radiation is the heat projected out from the wall to surrounding objects without regard to the air loss. The whole loss is in turn governed by the "conduction" factor which is the property of transmitting heat through the wall itself—from one surface to the other—by the contact of the particles of the wall with each other.

Increasing the thickness of a wall affects the conduction factor *but* a wall of double thickness has the same amount of exposed radiating surface and the same amount of exposed convection surface per square foot as a wall of only half the thickness. Therefore *if the conduction factor were not cut* **down** by the increase of thickness the loss for all thicknesses would be the same, per square foot per degree. The cutting down of the transmission factor however *does* produce a lesser heat loss *only* by lowering the temperature of the outside wall surface and to this extent only is the loss reduced by increasing the thickness.

It is also pertinent to note that no formula can give results which check absolutely with actual tests since the tests do not even check with each other and for a more accurate method and fuller description of the action of wall transmission the correspondent is referred to a very able paper by L. A. Harding read before The American Society of Heating and Ventilating Engineers at its nineteenth annual meeting in which this subject is treated with greater detail than we could find room to do here.

It is believed that the formula as we gave it is the simplest, easiest to remember, and as reasonably accurate for the purpose which we recommended, as any procurable. It is also desired to call our readers' attention to the fact that wall factors for practical use are not necessarily required to be of great refinement, as explained briefly in the second paragraph of Standard Data Sheet No. 1.

In regard to the second question, this point has already been raised by several other readers and again we can only repeat that the formula may not check to the second decimal place with the result of actual tests any more than the tests themselves check, one with the other.

Professor R. C. Carpenter Retires from Cornell University.

Professor R. C. Carpenter, head of the department of experimental engineering in the Sibley College of Mechanical Engineering, Cornell University, reaches the retiring age at the end of the present college year and will sever his connection with Cornell University at that time.

Respecting his retirement, the committee on general administration of the Board of Trustees, adopted the following resolution:

"*Resolved,* That the trustees in accepting the resignation of Professor Carpenter express their high appreciation of his services to the university for nearly thirty years. As a pioneer in the field of experimental engineering he is held in the highest esteem by all mechanical engineers, and by his writings in this field he has made an assured place for himself in the annals of his profession. As a teacher and investigator he is affectionately remembered by many generations of students and his retirement from the faculty of Sibley College will be viewed with great regret by all his colleagues."

It is Professor Carpenter's intention to continue his residence in Ithaca. He retires in good health and expects to maintain his activities in the fields of engineering investigation and research for several years to come.

As author of "Heating and Ventilating Buildings," now in its sixth edition, and through a vast amount of research work, much of which was directly connected with the art of heating and ventilation, Professor Carpenter has long occupied a commanding position in the profession. His many friends will join in congratulating him on the successful completion of his college services and in wishes for his continued health and success.

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German Measures for Safeguarding the Fuel Supply.

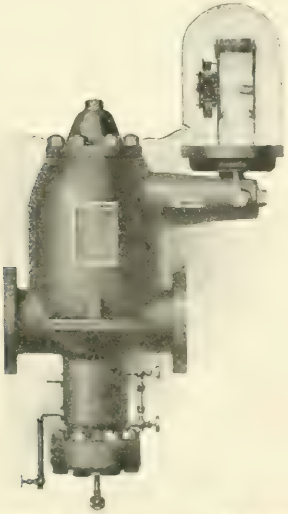
According to a report from the Havas correspondent at Geneva, Switzerland, the Berlin city government decreed that on account of the lack of freight cars and the impossibility of obtaining sufficient supplies of coal, houses which are served from central heating plants must not have a temperature of more than 59° F. All central heating plants were to cease operation March 31. Hot water supplied by the city to apartments was to be cut off immediately.

NEW DEVICES

New Straight-Way Type St. John Steam Meter.

A new "straight-way" type St. John indicating and recording steam meter has recently been placed on the market by the American District Steam Co., North Tonawanda, N. Y. This device is equally adaptable for measuring the flow of saturated or superheated steam, and is especially useful in measuring the quantity of steam used in the operation of engines, pumps, blowers, laundries, steam kettles, heating systems or drying rooms and other steam purposes. This meter is designed to measure the flow of steam at all pressures and under varying loads. Its usefulness to the seller and purchaser of steam is enhanced by its recording feature which shows, in chart form, a complete and continuous record of the steam used.

The only moving part of this meter is the valve and spindle which floats in the current of steam, the vertical movement of which is transferred to the pointer indicating in horse power the quantity of steam flowing. At the same time, the brass pencil, the movement of which is identical with the pointer, records on a metallic-treated paper ribbon, operated by clock work at a speed of ½-in. per hour. Therefore each day's record is recorded on 12 in. of the ribbon. The vertical movement of the valve and spindle is proportionate to the quantity of steam flowing, the movement of pointer and recording pencil being reduced somewhat by the arms mounted on spindle (0), as shown in the illustration (Fig. 2).



NEW TYPE OF ST. JOHN STEAM METER.

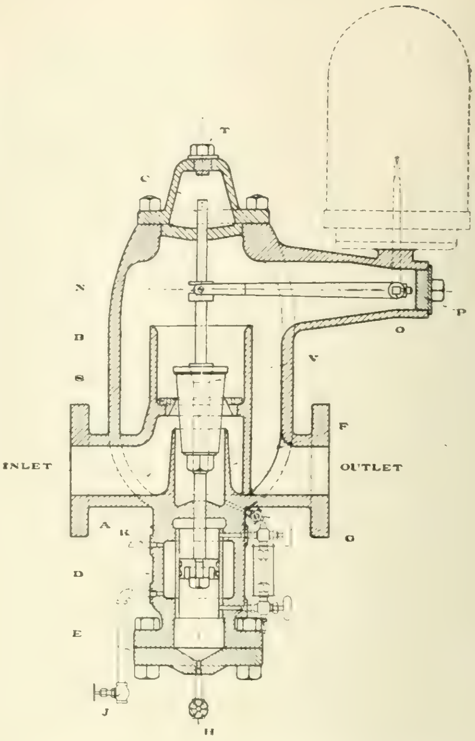


FIG. 2—CROSS-SECTION OF ST. JOHN METER.

The principle on which the St. John meter operates is that with a uniform difference of pressure on two sides of an orifice through which steam is flowing, with a constant initial pressure, the quantity passing bears a direct relation to the area of the orifice. The valve, or plug, is so tapered that the area of the orifice is increased in direct proportion to the rise of the valve, the weight of which is constant and requires a difference of pressure of about 2 lbs. to raise it from the seat, so the greater the steam demand the higher the valve floats, and its movement is recorded on the paper chart in the manner mentioned.

The operation of the meter is as follows: Steam enters the body of the meter (A) on the under side of the valve (V), and raising the valve—the height of which is governed by the quantity of steam flowing—passes to the outlet chamber (B). In the cross-section (S) is a Monel metal seat screwed into the portion of the casing which separates the spaces (A) and (B). (V) is the special bronze valve having a nickle steel spindle. This valve, when at its lowest position, fits closely in or on the Monel metal seat, thus shutting off entirely the flow of steam. As the tapered valve rises, the space between it and the Monel metal seat is the annular orifice through which the steam flows and increases to maximum when the valve is at the highest position, the rate of increase depending on the taper of the valve.

The movement of the valve is transferred to the pencil arm and thence to the chart through the spindle (0). In a recent bulletin, devoted to this new design of the St. John meter, are given full directions for calculating the quantity of steam used from the data given on the chart, as well as a detailed description of the meter itself. It is made in ten sizes, from 1-in. to 6-in. and with capacities, at 100 lbs. pressure, ranging from 27 B.H.P. to 1,000 B.H.P.

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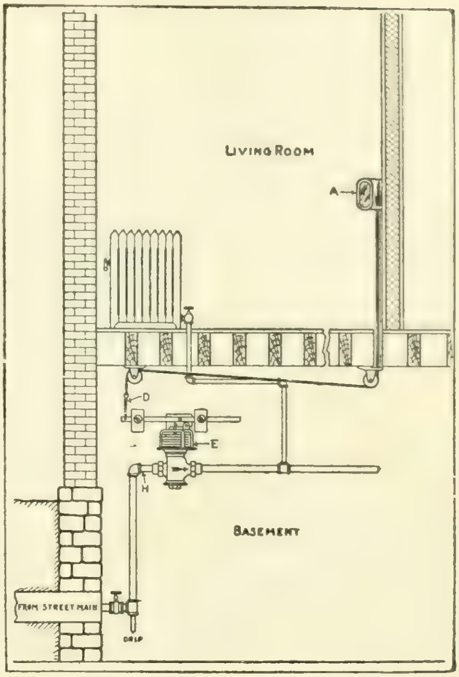
Controlling the Temperature with Central Station Heat.

The growth of the central station method of heating is bringing an increasing demand for effective means of regulating the temperature in buildings so supplied because, otherwise, the only way for the operator to regulate the temperature is by opening or closing the radiator valve or, when the rooms become overheated, opening the windows.

IDEAL SYLPHON REGITHERM.



REGITHERM AND REDUCING VALVE ON CITY STEAM MAIN.

A successful method for maintaining an even temperature under such conditions is provided by the Ideal Sylphon regitherm operated in connection with the Ideal Sylphon reducing valve. The regitherm is placed in the living room and is connected by a small wire cable to the reducing valve in the supply pipe, where it enters the basement from the street. When the room temperature becomes higher or lower than the point desired, the regitherm slightly closes or opens the reducing valve. This arrangement provides for just enough steam in the radiators to keep the rooms at the desired temperature.

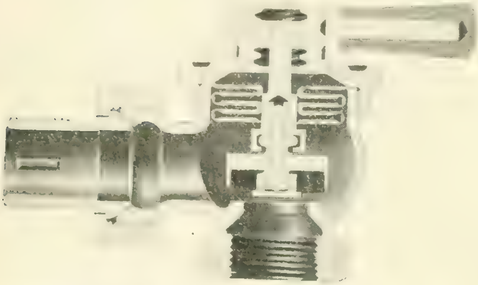
Following is the record of a two-weeks' test in a 10-room house at Overbrook, Pa., showing the economy possible with regitherm control over hand control. With practically the same outdoor temperature, the indoor temperatures, with hand control, ran from 65° to 80° F. in the daytime and from 45° to 70° F. at night, with regitherm control the temperature was maintained steadily at 70° in the daytime and at 60° at night. The average amount of water condensed per day, with hand control, was 1,500 lbs., and, with regitherm control, 1,300 lbs. From this it will be seen that there was a saving of 50c per 1,000 lbs., or 38 cents per day.

The regitherm is made entirely of metal. It can be set for any temperature from 60° to 80° F. and, it is stated, requires no attention at any time. There are no delicate parts or motors. This apparatus is manufactured by the American Radiator Co., Chicago, Ill.

The Dunham Radiator Trap in Central Station Heating.

The merit of central station heating is enhanced by high radiator efficiency. Any device that will aid in developing the highest efficiency in the radiation is a boon to this particular class of heating.

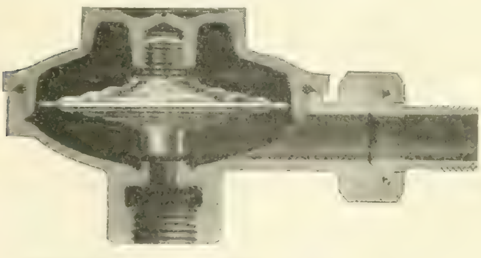
Among the radiator traps that possess notable advantages for this class of service, the Dunham trap, which is manufactured by the C. A. Dunham Co., Marshalltown, Ia., is a good example. It has the advantage, among others, of being simple in design. At the same time it is positive in action, has its working member open to the conditions which exist in the radiator and is thus subject to them and automatically controlled by them, so that the radiator is constantly relieved of air and water, while steam is held in the radiator to perform its maximum work.



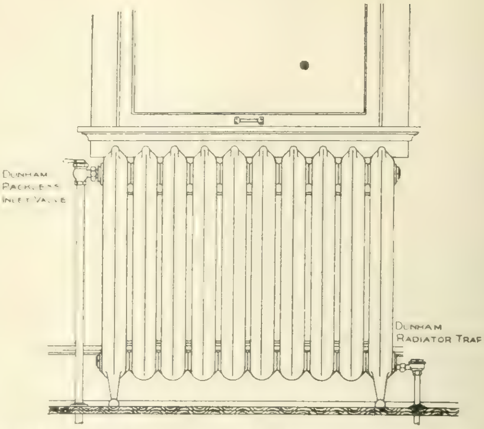
SECTIONAL VIEW OF DUNHAM PACKLESS INLET VALVE.

The Dunham trap consists of a body, a cover and the thermostatic disc which is secured in the cover. There are no loose parts, no sliding contacts and no guide or obstruction in the valve opening. It has a flat self-cleaning valve of unusually large area.

The Dunham packless inlet valve, shown in the accompanying illustration, is a fitting companion to the trap described. It is free from springs and packing of any sort. It is also a quick-opening valve. It is made only in angle pattern for use in a top inlet connection to the radiator. One noticeable feature is its low bonnet and steam; it does not project above the top of the radiator.



SECTIONAL VIEW, DUNHAM RADIATOR TRAP.



ARRANGEMENT OF SUPPLY AND RETURN CONNECTIONS TO RADIATOR WITH CENTRAL STATION SERVICE, OPERATING ON DUNHAM SYSTEM.

In central station heating service, the Dunham radiator trap and packless inlet valve are always installed as shown in Fig. 3.

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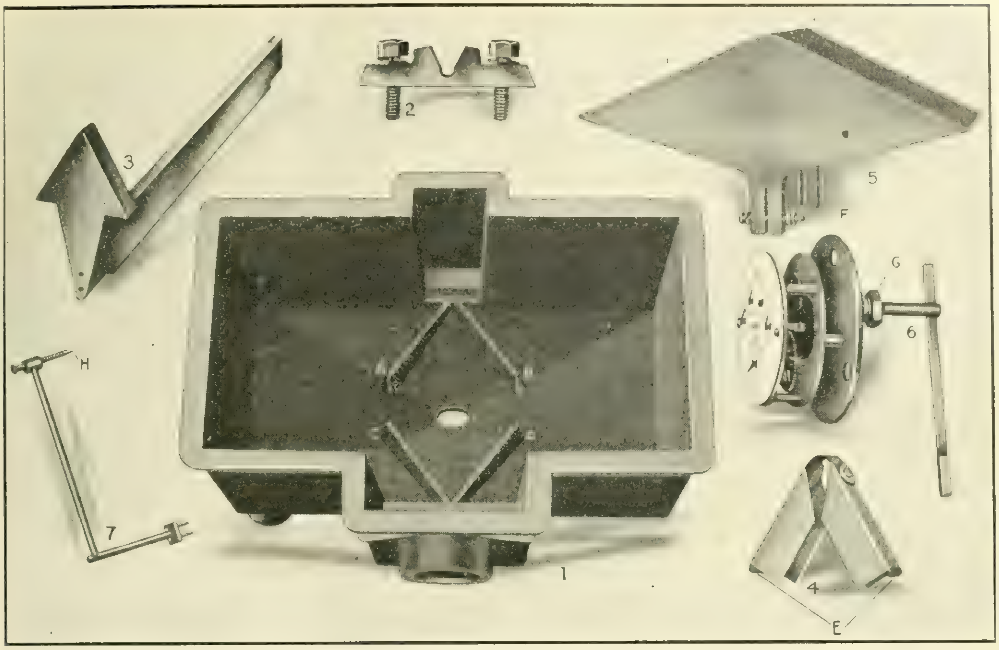
Construction of the Mason Condensation Meter.

The successful showing made in recent tests by the Mason condensation meter has aroused considerable interest in its construction details, which are shown herewith. The meter itself is reproduced on page 91. This meter was designed by Gilmore Mason, superintendent of the uptown system of the New York Steam Company, 105 East 63rd Street, New York, and has been on the market for about a year. Previous to that, however, a number of experimental installations were made, notably in the Riding Club Building and lately at the Stuyvesant High School, where the meter was operated in connection with a boiler test made under the direction of the New York Department of Education.

As will be seen from the illustration, the meter is notable for its simplicity, both in its parts and in its operation. The particular feature of locating original adjustments with an adjusting key is considered of unusual importance, as it is thus possible to avoid the customary overhauling and testing.

The Mason meter will shortly be manufactured on a large scale as it has already more than fulfilled the expectations of the designer. It embodies the results of Mr.



PARTS OF THE MASON CONDENSATION METER.

1—Cast-iron body. A, B, C, D—water deflectors.
2—Bronze bearings—two per set.
3—Bronze shaft.
4—Shock absorbing cap. E, shock absorbers.
5—Aluminum dumping bucket. F—bolt for shaft connections, two per set.
6—Counter. G—stuffing box.
7—Bronze adjusting key. H—adjusting pointer.

Mason's long experience in connection with meter testing and is based on his efforts to perfect a design requiring the minimum in meter maintenance.

Its principal features consist of (1) the inlet tank, consisting of water and sediment deflector; (2) outside access to adjusting screws; (3) simple operation of locating the original adjustment points, made possible by the use of an adjusting key which is connected to the bucket shaft by inserting the key through the opening immediately under the counter housing; (4) the arrangement of the water deflectors on the inner side of the bottom of the meter casing which causes a splash of water over the bearings during each discharge of the dumping buckets thus lubricating the bearings without grease or oil: and (5) the three bosses projecting from the bottom of the casing and tapped for 1¼-in. nipples, affording the major portion of a shelf or stand to support the meter body.

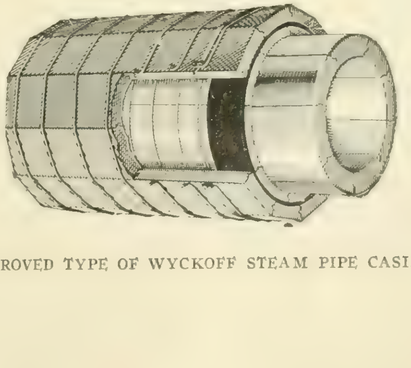
* * *

Wyckoff's Improved Steam Pipe Casing.

The latest type of pipe casing to be brought out by A. Wyckoff & Son, Elmira, N. Y., is illustrated herewith. It is made of cypress, the imperishable qualities of which have made it known as "the wood eternal." The casing is made up of two shells of cypress, the inner shell being 2 in. thick and the outer shell 1 in. thick. Both shells are spirally wound with heavy, galvanized steel wire. Between the shells is an annular air space ¼-in. thick. This separation is maintained, and the air made dead, by wrappings of asphaltum packing strips, each 4 in. wide at the ends of the casing. The wire wrappings in each case are drawn sufficiently tight to make the joints wholly water-proof.

The completed covering thus consists of two shells, with an air space between, making a non-conducting casing which offers great resistance to the radiation of heat.

This covering is made in lengths from 4 ft. to 12 ft., connected by a driving fit



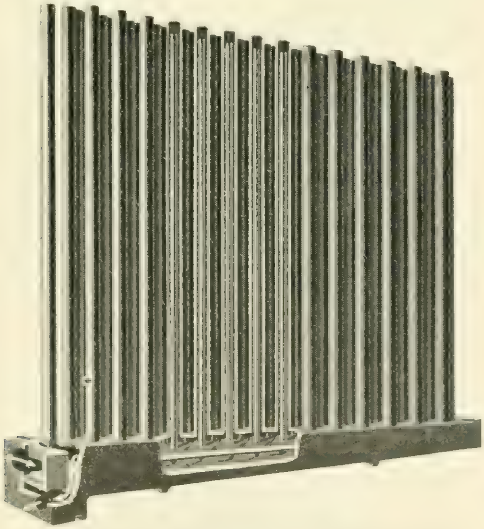
IMPROVED TYPE OF WYCKOFF STEAM PIPE CASING.

tenon and socket joint. The inner tube of the casing is lined with tin, when used on pipes which are subjected to more than 5 lbs. steam pressure. The manufacturers have recently published a pamphlet giving full details regarding the Wyckoff improved pipe casing which may be had on request by those interested.

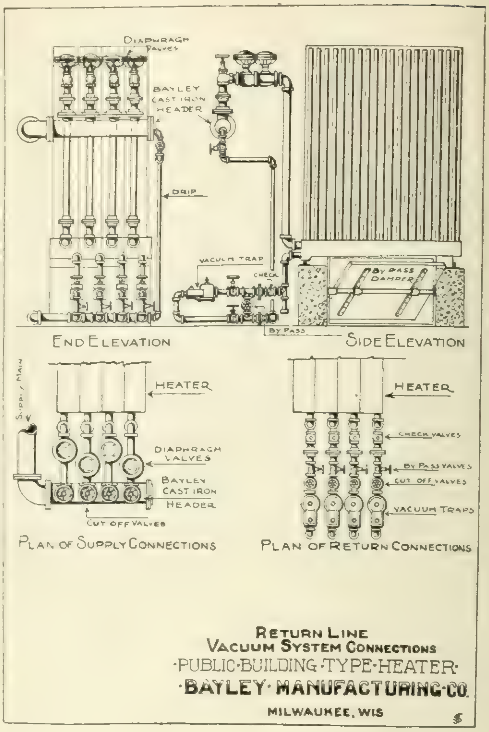
◆

Trade Literature.

Chinook Heaters, for indirect heating work, made by the Bayley Mfg. Co., Milwaukee, Wis., are the subject of a new engineering catalogue that constitutes a valuable addition to engineering literature. Carefully-compiled tables are given covering heating surface, free areas, dimensions and weights. Another series of tables covers final temperatures and condensations with steam at various pressures, ranging from zero pressure up to 125 lbs. from — 40° temperature of entering air up to 70°. There are 20 tables in this series and the data cover practically any condition that has to be met. Another large section of the catalogue is taken up with details of standard connections of the public-building type heater and the factory-type heater, for a wide variety of uses. Methods of computing the required sizes of heaters are also given, the catalogue concluding with some typical photographs of installations. The Bayley automatic steam trap, designed for use in connection with the Bayley heaters and the Bayley Plexiform fan are also shown and described. Size 8 x 10¾ in. Pp. 72.



CONSTRUCTION OF THE BAYLEY CHINOOK INDIRECT HEATER.



Reliable Evidence, presenting an imposing array of buildings equipped with the Reliable vacuum and vacu-vapor systems of heating, is the subject of a cloth-covered book that is being called afresh to the attention of the trade by the Bishop-Babcock-Becker Co., Cleveland, O. Several series of pages are given up to installations in different classes of buildings. For instance, office buildings equipped with the Reliable systems take up four pages; while bank buildings, government and public buildings, schools and colleges, theatres, clubs and associations, churches, hospitals and sanitariums, store buildings, factories and warehouses, hotels, apartment buildings, and residences are given equal prominence. The final pages of the book are given up to a description with cuts, showing the construction features of the Reliable VacUstat, which is a thermostatic valve used on air line vacuum heating systems; the vacutraps, heavy brass thermostatic valves used on return line vacuum heating systems; the Vacu-Graduate packless radiator valves, used on Reliable vacu-vapor heating systems, and the Reliable vacuum pump, electric or hydraulic, made in various sizes with different capacities. Size 8 x 11 in. Pp. 48.

Central Station Heating Notes.

Frankfort, Ind.—Frankfort citizens are opposing a proposed increase in the heating rates of the Frankfort Heating Company on the ground that there is an unnecessary loss of heat in the company's mains. The matter is now before the Indiana Public Service Commission. It was thought possible that extensive repairs in the insulation of the mains will be made.

Goshen, Ind.—The *Goshen Democrat* is agitating the proposition of establishing a central station heating plant in that place.

Youngstown, O.—Typical difficulties experienced by many district heating companies during the past winter were recounted by Harry Engle, secretary and treasurer of the Mahoning Valley Lighting Company in explaining the causes for the unsatisfactory heating of the Rayen School, which is supplied from the company's mains. Mr. Engle explained that the plant was first put out of commission by the corrosion of the boilers due to acids in the river. The next trouble, which developed soon after the first of the year, was due to inability to get coal, when all the plants in that locality suffered from the same trouble. The next breakdown was caused by an accident to the coal conveyor, Mr. Engle stating that the scarcity of coal made it necessary to use a larger size than the conveyor was designed to handle. The final accident was a breakdown of the fan furnishing forced draft for the largest boiler.

Cleveland, O.—The proposed extension of the municipal steam heating plant to give service to practically all the homes in Cleveland, which was the purpose of an ordinance introduced in the council recently by Councilman Sulzmann, is not favored by Commissioner of Heat and Light Davis, who stated that he would make an adverse report on the proposition. According to the plan proposed, the city heating plant was to have its system extended in connection with the $3,000,000 pragramme for street improvements. Mr. Davis stated that the city lost $50,000 last year on what heat it now manufactures. "With the coal cost soaring," he added, "we will probably lose much more this year."

Danville, Ill.—In connection with the repaving of West Main Street, business men and property owners have asked the council to start mandamus proceedings to compel the extension of the steam heating lines on West Main Street, from Clark Street west to Gilbert Street. It was first planned to circulate a petition to this effect, but it was felt that quicker action could be secured through mandamus proceedings.

Louisville, Ky.—The City of Louisville has won its case against the Kentucky Heating Company for back taxes on its franchise, running back to 1912 . The amount of the judgment, as adjudged by the Court of Appeals, is $26,648. The court held that the action of the Board of Equalization of Louisville, in assessing the company's franchise at $1,500,000, was a final action. The court also stated that it could not recall any case where the right is given to the court to review the assessment of a city board whose action is prescribed by the statute to be final. The whole question in this case was whether the board had the authority to make a final assessment of the franchise of the company. The heating company, which is now a part of the Louisville Gas & Electric Co., claimed that its franchise expired in 1908, and that it could not be held liable for the right to operate after the expiration of the franchise. The city contended that the tax was against tangible property held by the company and not on the right to operate.

Wataga, Ill.—The *Wataga Visitor* states that a number of business men of Watseka are planning to install a large heating plant in the rear of their buildings for heating the business district. Dissatisfaction with the operation of the city heating plant is given as the reason for the movement.

Davenport, Ia.—The city council has granted the petition of the People's Light Company, asking that the heating franchise held by the Davenport Gas & Electric Company be transferred to the first-named concern.

New Ulm, Minn.—In a report made to the city council on the operation of the municipal heating plant of the New Ulm Heating Company, it was stated that meters were installed early in January and it was desired that the council concur in fixing the rate for the steam consumed during the time previous when the plant was operated without meters. There are at present 31 consumers and the January income was $1,280. The company thought that a 25% reduction from the heat used during the month of January would be a just settlement to the city and to the consumers for the heat used during December. The company also considered that 50% of the heat used during January would be an equitable adjustment for the heat used during November. On this basis, which was endorsed by the council, the estimated income for December was $870 and, for November, $349. No charge was made for heat used during the latter part of October. A board of managers was appointed to have general charge of the heating company, consisting of two directors of the company,

F. W. Johnson and A. J. Vogel, and two members of the city council, Councilmen Hamann and Krook.

Minneapolis, Minn.—The Minneapolis Steam Company is being organized and has applied for a franchise to pipe steam through the streets of the city. The project has aroused considerable interest on the part of the civic organizations of the city. At a meeting of the Minneapolis Civic Improvement Association, a letter was read from H. C. Kimbrough, Western manager of the American District Steam Company, explaining the company's proposition. It is expected that a number of public hearings will be arranged before definite action is taken.

Des Moines, Ia.—The heating franchise asked for by the Des Moines Electric Company has been favorably acted upon by the city council and March 26 was set as the date for a special election on the proposition. The Des Moines Electric Company and the city were each to bear half the cost.

Price, Utah.—A proposal has been made by J. H. Manson to the city council of Price to operate the local municipal light plant for 25 years and as rental to pay off the $25,000 bonds with interest. In addition Mr. Manson asks a franchise for the laying of steam pipes in the business district of Price for supplying heat to business blocks and other buildings, including the court house, school house and tabernacle.

Salt Lake City, Utah.—The franchise asked for by the Utah Power & Light Company for the establishment and maintenance of a central heating plant has been granted by the city commission. The franchise is dual in form, being really two franchises. By one, permission is granted to establish a steam heating plant and give service to any part of the city. By the other, the privileges as to heating service formerly held by the Utah Light & Traction Company are transferred to the Utah Power & Light Company. The purpose of the power company is to engage in the furnishing of steam heat over as wide an extent of the city as may practicable. To this end various heating plants in the business district will be connected and unified with those already operated in conjunction under the old franchise of the Utah Light & Traction Company. One of the first moves to this end was the purchase by the Utah Power & Light Company of the power plant of the two large Newhouse buildings—the Newhouse and the Boston—which recently changed hands. This plant served these two buildings, as well as the Newhouse Hotel, the Commercial Club and other adjoining buildings. The power company is planning to make the Church heating plant the center of its heating system, with the Newhouse plant as an auxiliary. A 20-in. main will be laid south through the center of the blocks, between Main and West Temple Streets, from South Temple to the Kearns Building and thence to the Newhouse Hotel, thence east to the auxiliary plant and north through the centers of the blocks between Main and State Streets to South Temple Street, forming a rectangle. These mains will act as feeders for branches in various directions. Mayor Ferry was authorized to enter into a 10-year contract with the power company for power to operate the pumping plant at Utah Lake, in which the city is interested.

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Standard Heating and Ventilating Data Sheets.

Previously-published data sheets, similar to those appearing on Pages 59-63 of the present issue, are as follows:

FEBRUARY, 1917, ISSUE.

No. 1—B.T.U. Losses.
No. 1-A—B.T.U. Losses—Brick.
No. 1-B—B.T.U. Losses—Stone and Concrete.
No. 1-C—B.T.U. Losses—Combinations.

MARCH, 1917, ISSUE.

No. 1-D—B.T.U. Losses—Tile.
No. 1-E—B.T.U. Losses—Frame Construction.
No. 1-F—B.T.U. Losses—Glass, Skylight and Miscellaneous.
No. 1-G—B.T.U. Losses—Ceiling, Floor and Roof.

Copies of these sheets, printed, separately, on one side only, may be obtained at 5 cents each. The attention of readers is also called to the special binder for holding these sheets, which is now ready. The price of the binder is $1.00, postpaid.

◆

Harrison W. Craver, chief librarian of the Carnegie Library of Pittsburgh since 1908, has tendered his resignation to accept a position as director of the library of the United Engineering Societies of New York. The United Engineering Societies library is now believed to be the largest engineering library in the world, with approximately 150,000 volumes on technological subjects on its shelves.

EXPOSURE.

The exposure factor is closely allied to the leakage factor inasmuch as the exposure factor usually covers a greater percentage than the simple difference in outside air temperature would produce. In proof of this it is a generally accepted fact that the outside air on the south side of a building will average about 10 degrees warmer than on the north side during the day. Yet many methods of computing radiation involve an increase of 25% to 33 1/3% for north exposure.

For well-constructed buildings in locations of only reasonable exposure the additional allowance for exposure should be made as follows:

	Unventilated Rooms.	*Ventilated Rooms.*
South	0%	10%
East	10%	20%
West	10%	20%
North	15%	25%

For badly exposed buildings a larger allowance for exposure should be made as follows:

	Unventilated Rooms.	*Ventilated Rooms.*
South	10%	20%
East	20%	30%
West	20%	30%
North	25%	35%

The reason for allowing a little higher exposure factor in the ventilated rooms is that such rooms have no leakage figured (as is explained under "Leakage") and, on windy days when the room is on the windward side, the cold air may rush in around the windows to a discomforting degree unless some little additional surface is provided.

On the other hand, in an unventilated room leakage for a complete change of air every hour is figured and this is sufficient to care for all ordinary contingencies.

LEAKAGE.

Leakage is the most variable quantity with which the designer of a heating plant has to deal. At the time a heating system is designed it is to a great extent a gamble on what the final construction of a building will be, and many contemplated helps to the heating of a building may later be abandoned in order to cheapen up the cost. Metal sash, weather-strips, double windows, etc., may never finally be used, however positively they may at first be specified, and too much dependence must not be placed on such aids.

In the ordinary, well-constructed building the figuring of *one air change per hour* for leakage in all unventilated rooms and spaces will be entirely sufficient. This has been proven time and again in practical experience and, while at certain widely-separated times the leakage may exceed this, these periods are of such short duration that there is enough leeway on the amount of surface installed to carry over such a brief time without any serious discomfort.

B.T.U. REQUIRED PER CUBIC FOOT FOR VARIOUS AIR CHANGES AND TEMPERATURE RANGES.

Temp. Rise Degrees Fahr.	No. of Air Changes per Hour								
	½	1	1½	2	3	4	5	6	10
5	0.05	0.09	0.14	0.18	0.27	0.36	0.45	0.55	0.91
10	0.09	0.18	0.27	0.36	0.55	0.73	0.91	1.09	1.82
15	0.14	0.27	0.41	0.55	0.82	1.09	1.36	1.64	2.73
20	0.18	0.36	0.55	0.73	1.09	1.45	1.82	2.18	3.64
25	0.23	0.45	0.68	0.91	1.36	1.82	2.27	2.73	4.55
30	0.27	0.55	0.82	1.09	1.64	2.18	2.73	3.27	5.45
35	0.32	0.64	0.95	1.27	1.91	2.55	3.18	3.82	6.36
40	0.36	0.73	1.09	1.45	2.18	2.91	3.64	4.36	7.27
45	0.41	0.82	1.23	1.64	2.45	3.27	4.09	4.91	8.18
50	0.45	0.91	1.36	1.82	2.72	3.64	4.55	5.45	9.09
55	0.50	1.00	1.50	2.00	3.00	4.00	5.00	6.00	10.00
60	0.55	1.09	1.64	2.18	3.27	4.36	5.45	6.55	10.91
65	0.59	1.18	1.77	2.36	3.54	4.72	5.91	7.09	11.82
70	0.64	1.27	1.91	2.54	3.82	5.09	6.36	7.64	12.72
75	0.68	1.36	2.05	2.73	4.09	5.45	6.82	8.18	13.63
80	0.73	1.45	2.18	2.91	4.36	5.82	7.27	8.72	14.54
85	0.77	1.55	2.32	3.09	4.64	6.17	7.73	9.27	15.45
90	0.82	1.64	2.46	3.27	4.91	6.55	8.18	9.83	16.36

Note—This table based on 1 B.T.U. raising 55 cu. ft. of air 1° F.

Example:

A room 14 ft. x 14 ft. x 10 ft. has a radiation loss of 5,000 B.T.U. and a leakage loss estimated at 1½ changes per hour with outside air 10° F., and inside temperature of 70° F. This is a temperature rise of 70° — 10° = 60°.

In the table, under 1½ air changes and opposite 60°, is found the factor 1.64. The cubic contents, 14 x 14 x 10 or 1960 cu. ft. x 1.64 = 3214 B.T.U. for leakage.

Total loss = 5000 + 3214 = 8214 B.T.U.

TEMPERATURE RANGE.

A building in a given locality is subject to certain environments which have much to do in deciding its heating requirements.

It may be exposed to cold winds and set on a prominent elevation or it may be in a sheltered position and protected by hills, forests, or other nearby buildings.

The temperature range in a given locality may be extreme for long and continuous periods of time or it may reach an extreme but rarely and, then, for a brief interval of hours only.

A locality which goes down to zero only once in two or three years and which has the zero weather last only a half a day or less can safely be figured for 5° or even 10° above zero. But for a locality which goes down to 5° above and then hovers around such a temperature for a week or more it would be much wiser to figure it at zero.

LOWEST TEMPERATURES IN THE UNITED STATES.

State and City	Lowest Temp. Degrees Fahr.	State and City	Lowest Temp. Degrees Fahr.
Alabama		*Georgia*	
Birmingham	2	Augusta	3
Mobile	—1	Atlanta	—8
Montgomery	—5	Savannah	8
Arizona		*Idaho*	
Flagstaff	—17	Boise	—28
Phoenix	12	Lewiston	—18
Yuma	22	Pocatello	—20
Arkansas		*Illinois*	
Fort Smith	—15	Cairo	—16
Little Rock	—12	Chicago	—23
California		Springfield	—22
Fresno	20	*Indiana*	
Independence	10	Indianapolis	—25
Los Angeles	28	Evansville	—15
Sacramento	19	*Iowa*	
San Diego	32	Des Moines	—30
San Francisco	29	Dubuque	—32
Colorado		Keokuk	—24
Denver	—29	Sioux City	—3
Grand Junction	—16	*Kansas*	
Pueblo	—27	Concordia	—25
Connecticut		Ft. Dodge	—26
Hartford	—14	Wichita	—22
New Haven	—14	*Kentucky*	
Southington	—19	Louisville	—20
District of Col.		*Louisiana*	
Washington	—15	New Orleans	7
Florida		Shreveport	—5
Jackson	10	*Maine*	
Key West	41	Eastport	—21
Pensacola	7	Portland	—17
Tampa	19	*Maryland*	
		Baltimore	—7

LOWEST TEMPERATURE IN THE UNITED STATES.

State and City	Lowest Temp. Degrees Fahr.
Massachusetts	
Boston	—13
Michigan	
Alpena	—27
Detroit	—24
Marquette	—27
Pt. Huron	—25
Minnesota	
Duluth	—41
Minneapolis	—33
Moorhead	—48
St. Paul	—41
Mississippi	
Meridian	—6
Vicksburg	—1
Missouri	
Hannibal	—20
Kansas City	—22
St. Louis	—22
Springfield	—29
Montana	
Havre	—55
Helena	—42
Kalispell	—28
Miles City	—49
Nebraska	
North Platte	—35
Lincoln	—26
Omaha	—32
Valentine	—38
Nevada	
Carson City	—22
New Hampshire	
Concord	—35
New Jersey	
Atlantic City	—7
Cape May	—7
New Mexico	
Roswell	—18
Santa Fe	—13
New York	
Albany	—24
Binghamton	—26
Buffalo	—14
New York	—6
Oswego	—23
Saranac Lake	—38
North Carolina	
Charlotte	—5
Hatteras	8
Wilmington	5
North Dakota	
Devils Lake	—51
Bismarck	—44
Williston	—49

State and City	Lowest Temp. Degrees Fahr.
Ohio	
Cincinnati	—17
Columbus	—20
Toledo	—16
Oklahoma	
Oklahoma	—17
Oregon	
Baker City	—20
Portland	—2
Roseburg	—6
Pennsylvania	
Erie	—16
Philadelphia	—6
Pittsburgh	—20
Rhode Island	
Providence	—12
Block Island	—4
South Carolina	
Charleston	7
Columbia	2
South Dakota	
Huron	—43
Pierre	—40
Yankton	—32
Tennessee	
Chattanooga	—10
Knoxville	—16
Memphis	—9
Nashville	—13
Texas	
Amarillo	—16
Corpus Christi	—11
El Paso	—5
Ft. Worth	—8
Galveston	8
San Antonio	4
Utah	
Salt Lake City	—20
Vermont	
Burlington	—25
Northfield	—32
Virginia	
Lynchburg	—6
Norfolk	2
Washington	
Seattle	12
Spokane	—30
Walla Walla	—17
West Virginia	
Elkins	—21
Parkersburg	—27
Wisconsin	
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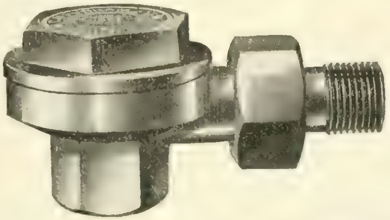

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Investigate. Write for Bulletin No. 5

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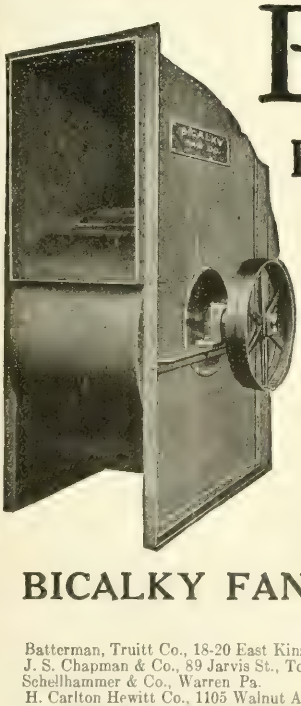

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are used all over the country and abroad. They are specified by leading engineers and architects. Their design and construction permit operating these fans at the highest pressure without racking.

The efficiency obtained with these fans has upset all previous engineering dope.

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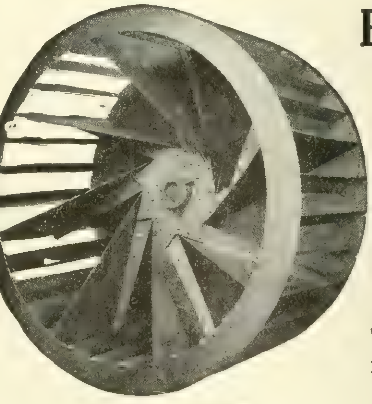

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are built exceptionally strong. They are guaranteed to stand up and do not rack under the heaviest work that fans are subjected to.

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Chas. W. Carll's Sons, 3-7 West Front St., Trenton, N. J.
The O'Keefe-Hayward Co., 1932 Dime Bank Bldg., Detroit, Mich.
Sink & Edwards, 519 Massachusetts Ave., Indianapolis, Ind.
J. M. Miller Sales Co., 2008 McKinney Ave., Dallas, Texas.
Eagle Roofing & Art Metal Works, 203 Cass St., Tampa, Fla.

THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. MAY, 1917 1123 Broadway, New York

Air Conditioning for Factory Offices

Heating and Ventilating Equipment for Plant of the B. J. Johnson Co., Milwaukee, Wis.

Each time the sand runs through the hour glass at the plant of the B. J. Johnson Soap Co., Milwaukee, Wis., 14,400 cakes of Palmolive soap are produced—four cakes a second, 240 cakes a minute, 14,400 cakes an hour for every working day. This remarkable output is due, in no small measure, to the elaborate arrangements for conditioning the air on the three upper floors of the solid concrete structure that serves both as the company's factory and general offices. The three floors supplied by the system are occupied by the gneral offices. There is also a branch duct leading to the lunch room on the fifth floor.

The balance of the factory is heated with exhaust steam and direct radiation.

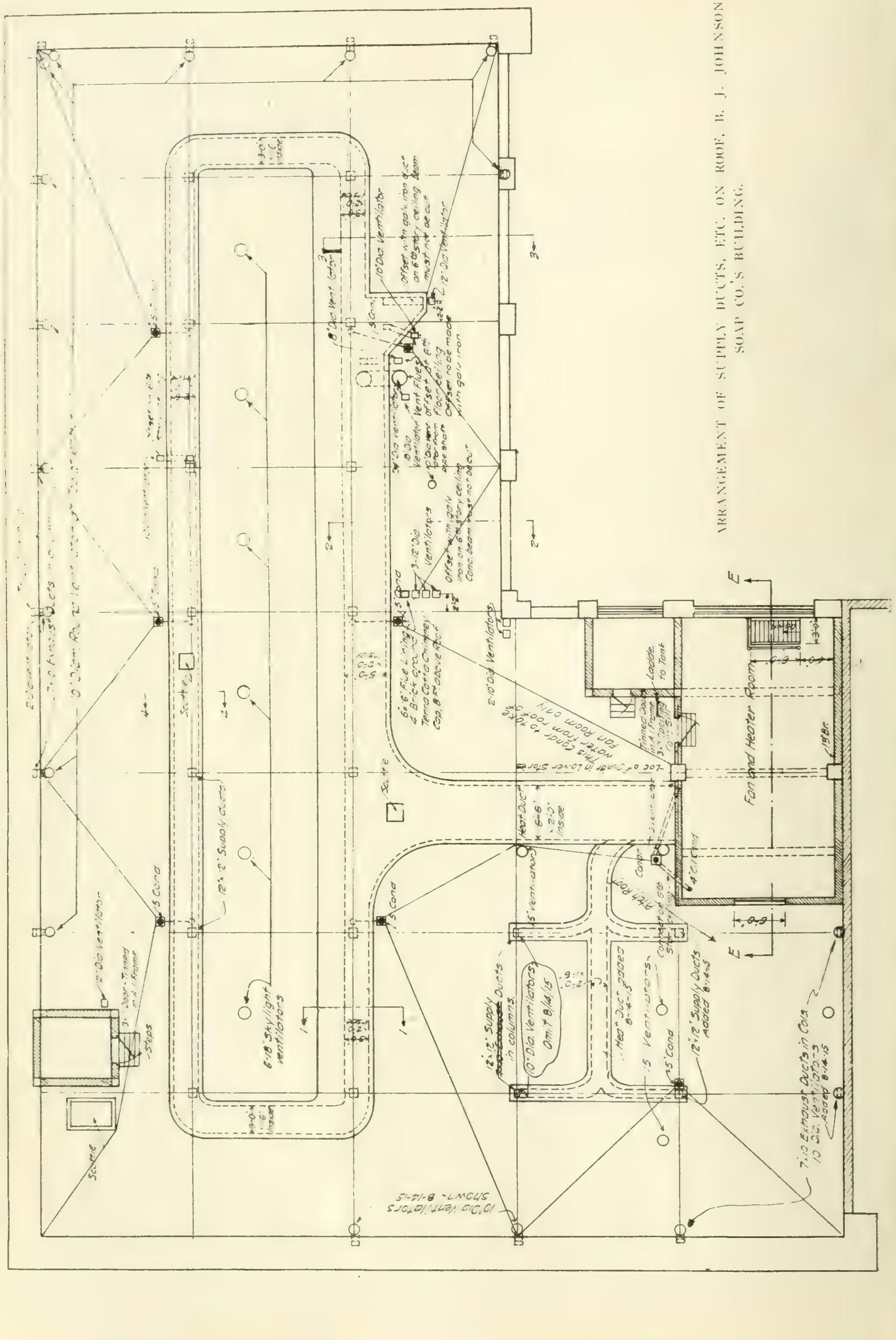
Every effort has been made to reduce to a minimum waste spaces throughout the building and to this end the hollow supporting columns have been utilized as fresh air ducts. The designers have even gone a step further in having the distributing ducts run along the roof to the hollow concrete columns. This required careful insulation of the roof ducts, as shown in the accompanying illustrations.

With this arrangement of air supply no floor space is used for radiators on the three upper floors.

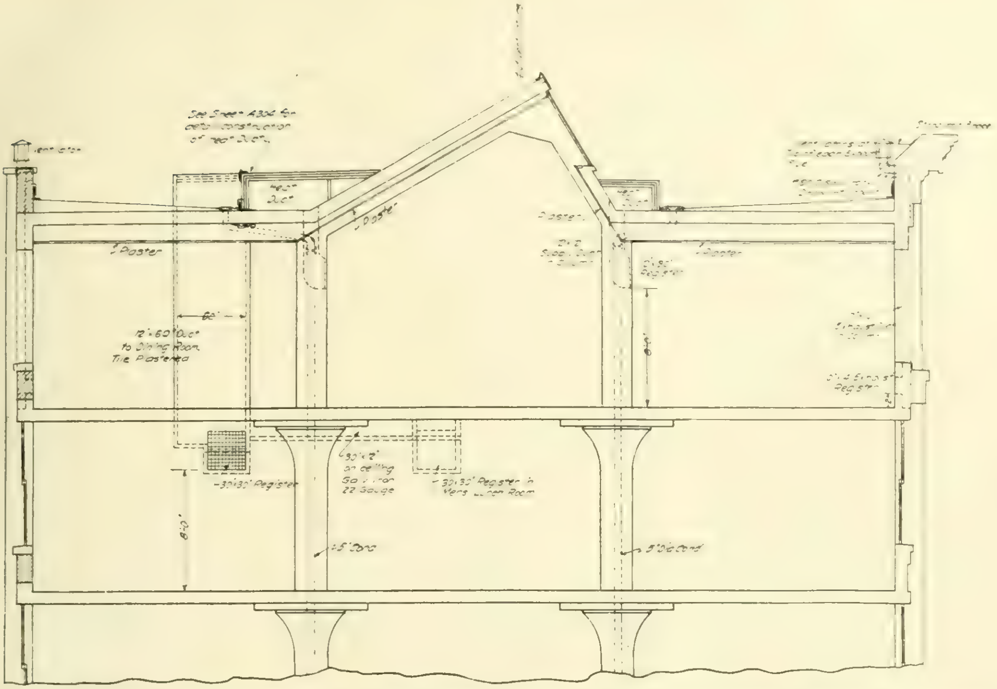
Another departure from the usual is to be noted in the exhaust system. The used air is carried by its natural tendency to rise through ducts with openings near the floor line. This system is supplemented in the summer time by dampers, set in the skylight on the top floor. These dampers must be kept closed in winter when the fan is pumping hot air, as otherwise they would interfere with the circulation. In the summer, when the air from the fan is cooled by the air washer (the heating coils being turned off) the used air is the warmer and tends to rise and bank in the skylight. In warm weather, therefore, the double exhaust through both ducts and dampers add considerably to the flexibility and efficiency of the system.

The fan and air washer equipment is located on the roof of the building. It includes a Sirocco engine-driven fan having a capacity of 19,000 cu. ft. of air per minute. The heater is made up of a tempering coil containing 570 sq. ft. of Vento radiation and a reheating coil containing 1,140 sq. ft. of Vento radiation. The fan is driven by a vertical center-crank 6 in. x 5 in. engine. The water for the air washer is circulated by a small motor.

There have been one or two changes made since the original installation was completed. It was found that some form of local adjustment was necessary on the outlets, as some employees preferred


Fan and Heater Room
Ladder to Tank
Tinned Door in A.I. Frame
6-18" Skylight ventilators
12"x12" Supply Ducts
10" Dia. Ventilator
8" Dia Vent
12" Dia Ventilator
Offset with galv. iron duct on 6th story ceiling beam must not be cut
Offset to be made with galv. iron
3-12" Dia. Ventilators
This Cond. to take water from roof of Fan Room only
Heat Duct 6-6 2-0 inside
5" Cond
4" C.I. Cond
2'-10" Dia. Ventilators
Scuttle
Steps
2" Dia Ventilator
3' Door Tinned in A.I. Frame
10" Dia Vent'lators shown - 8-14-15
7-10 Exhaust Ducts in Cols 10 Dia. Ventilators - 3 Added 8-14-15
12"x12" Supply Ducts Added 8-14-15
12"x12" Supply Ducts in columns.
10" Dia. Ventilators Omit 8/14/15
Heat Duct added 8-14-15
5 Ventilators
Pitch Roof
E
E
1
2
3
4

ARRANGEMENT OF SUPPLY DUCTS, ETC. ON ROOF, B. J. JOHNSON SOAP CO.'S BUILDING.

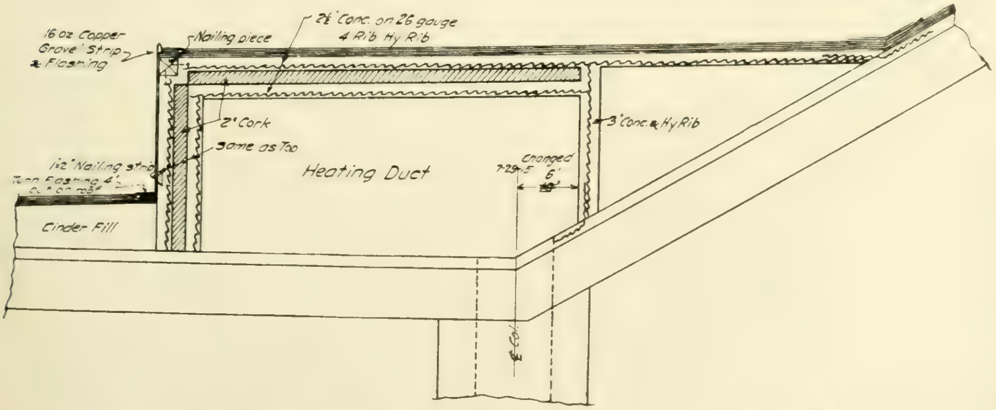


SECTION OF B. J. JOHNSON SOAP CO.'S BUILDING, SHOWING AIR DISTRIBUTION THROUGH BUILDING COLUMNS.

more or less air than others, and while the original installation provided polished brass register faces only, there have since been installed individual shutters of a deflecting pattern on each outlet. These shutters, when open, deflect the air to a more nearly horizontal travel, and may be closed tightly, in a similar manner to ordinary register dampers. They are operated by chains from the floor.

In the construction of the hollow ducts in the columns no particular difficulties were met with, and sheet metal forms were constructed in advance and anchored into place in the wood forms previous to the pouring of concrete. Before pouring concrete these metal forms were filled with dry sand which was allowed to run out after the concrete was set.

The construction of the roof duct did not offer any particular difficulties, and was carried out exactly in the manner indicated by the drawings.

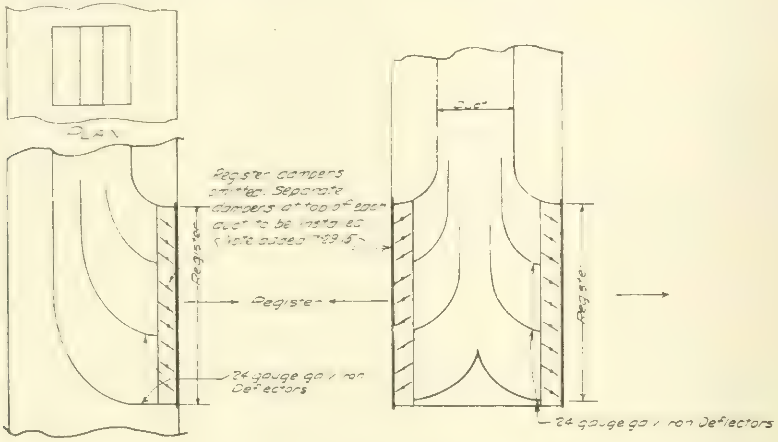


INSULATION FOR HEAT DUCT ON ROOF, B. J. JOHNSON SOAP COMPANY BUILDING.

As originally installed there was a deflecting damper in the horizontal duct at the top of each vertical shaft. It was expected to be able to set these permanently in positions which would insure an equal supply of air to each, but due to the causes above mentioned it was later found more desirable to have individual control which could be varied from day to day on each outlet.

The operation of the system is very satisfactory and provides the best of air at all times in the office.

The arrangements for taking air out of the room will doubtless be clear on inspection of the drawings.


Plan
Duct
Register dampers omitted. Separate dampers at top of each duct to be installed (Note added 7-29-15)
Register
Register
Register
24 gauge galv iron Deflectors
24 gauge galv iron Deflectors

DEFLECTORS IN SINGLE DISCHARGE REGISTERS PROVIDED FOR ALL SUPPLY DUCTS.

The exterior columns of the building contain exhaust ducts with openings near the floor, the idea, as stated, being to open dampers into these during the Winter so that the cooler air will be taken from the roof. In the Summer these dampers will be shut and air will be allowed to escape through the ventilators along the top of the skylight, this taking the warmest air out of the room.

Arrangements have been made for circulating cold water from an artesian well in the air washer for slight cooling effect in Summer, and it has further been contemplated to install a brine coil in the air washer tank, as this plant is already equipped with refrigeration and it would simply mean the extension of brine piping for a short distance. This could be used in extremely hot summer weather such as we experienced last summer.

The heating and ventilating equipment was designed by S. B. Lincoln, engineer for the Chicago office of Lockwood, Greene & Co., architects and engineers.

Coke in a Residence Heater Designed For Coal

By DONALD B. PRENTICE, M.E.
Instructor in Mechanical Engineering, Yale University

The high price of anthracite coal has led many householders in the Eastern cities to seriously consider the feasibility of substituting some other less expensive fuel for warming their homes. Gas companies, naturally, have taken advantage of the situation to urge the merits and use of coke, their most important by-product. At the present time and also under normal conditions coke can be sold at a price 20% to 25% lower than stove or chestnut sizes of anthracite coal, even allowing for the lower heat value per pound of the coke. This is, of course, largely due to the fact that coke is produced from bituminous coal in the process of gas manufacturing and bituminous is invariably cheaper than anthracite.

Although impressed by the material saving in cost, many amateur firemen are skeptical of the satisfactory behavior of coke in ordinary furnaces and feel that they could not maintain comfortable conditions in their homes. They know that coke burns rapidly, unless the draft is very light; and they believe that it would be impossible to produce reasonably uniform warmth in a residence without more frequent attention than they can give.

The 30-hour continuous test reported in detail below was made to study the peculiarities and suitability of coke as a fuel in a small standard-type boiler designed for anthracite coal. Broken coke, furnished by the New Haven Gas Light Co., was used. This is about equivalent in size to a mixture of stove and nut anthracite. The test was made on a cast-iron sectional boiler which forms part of the house heating boiler test plant at the Mason Laboratory of Mechanical Engineering of the Sheffield Scientific School, Yale University.

VARIATION IN WEIGHT OF COKE.

Broken coke is sold by the New Haven Gas Light Company, at retail, by the bushel, fifty bushels being considered the equivalent of a ton. As coke absorbs moisture freely selling by weight would be unsatisfactory and might lead to misunderstandings with customers. The bulk of a ton will vary 10% or more, depending on the moisture content. In this particular test the coke averaged 47.84 lbs. per bushel, and the analysis gave 8.35% moisture and a heat value of 12,670 B.T.U. per pound dry. Fifty bushels, therefore, contained about 2,200 lbs. of dry coke. If anthracite coal, has a heat value of 13,000 B.T.U. per pound as purchased, fifty bushels of coke are equivalent in potential heat value to 2,140 lbs. of coal.

As a matter of interest and to furnish a basis for comparison a test of this same boiler with anthracite stove coal has been reported in adjoining columns to the coke test.

RESULTS OF COKE TEST.

The results of the coke test may be summarized briefly:

1. The overall efficiency of the boiler with coke is slightly higher than with coal; which is partly due to the smaller size of the coke, partly due to its burning more completely, and partly due to the lower output at which the boiler was operating. The coke requires more frequent attention to check holes developing in the fire bed. These holes are not large, but the air leaking through them would lower the efficiency somewhat if they were allowed to remain.

2. The coke charges in this test were about all the boiler could accommodate without losing steam pressure for too long a period to be satisfactory. With a firing of 175 lbs. pressure was lost for 20 minutes, on the average; when 225 lbs. were fired no pressure was shown on the gage for 40 minutes. With stove coal 250 lbs. can be fired at one time with no longer loss of pressure than for 175 lbs. of coke. Results are secured, of course, when operating at an output equal to at least 75% of rating.

3. From a financial standpoint heating with coke is about 20% less expen-

sive than with stove anthracite, and corresponds closely to the cost with pea anthracite. This latter fuel cannot be burned in many residence boilers, however, on account of insufficient draft. At the present prices, $7.75 for 50 bushels of coke and $9.75 for a ton of stove anthracite, the costs of fuel for serving 1,000 sq. ft. of radiation one hour would be $0.1045 and $0.145, respectively, which increases the relative saving of coke.

4. A coke fire in a coal furnace would not satisfactorily warm a house unless it received attention morning, noon, and night in ordinary winter weather, and every three hours in extreme weather. This statement is based on the supposition that the furnace is suited to the load it has to carry; i.e., is not very much oversize. The coke would require nearly twice the bin capacity and would be somewhat dustier in the cellar than coal. Offsetting these disadvantages is a saving of 20% in cost of fuel. A hot-water heating system tends to make larger firings of coke practicable by carrying, with its stored heat, the period during which pressure would be lacking in the steam system.

The following coke analyses illustrate the extent to which the moisture content varies. The decreasing proportion was due to storage in a heated building.

	1	2	3
Moisture	8.35	5.15	0.33
Volatile	3.58	4.58	3.10
Fixed Carbon	76.85	79.98	84.45
Ash	11.22	10.29	12.12

These analyses, reduced to a dry-coke basis, give:

	1	2	3
Volatile	3.92	4.83	3.12
Fixed Carbon	83.81	84.35	84.70
Ash	12.27	10.82	12.18

Data and Results of Evaporative Test of a House-Heating Boiler.

1. Test of cast-iron, sectional, heating boiler located at Mason Laboratory to determine characteristics of coke fuel, conducted by D. B. Prentice.
2. Kind of furnace: hand-fired, rocking grate. Depth, bottom of fire door to grate, 10 in. Mean height, grate to bottom of section above, 18 in. Fuel capacity at one charge on kindling fire, 225 lbs. coke.
3. Grate surface: width, 22.5 in.; length, 43 in.; Area, 6.75 sq. ft.
4. Water-heating surface: Direct, 24.13 sq. ft.; indirect, 78.1 sq. ft. total, 102.23 sq. ft.
5. Superheating surface, sq. ft. 17.4.
6. Date. Coke test, Dec. 23-24, 1914. Coal test, April, 22-23, 1913.
7. Duration. Coke test, 29.83 hrs. Coal test, 33.67 hrs.
8. Kind and size of fuel, Broken gas coke; anthracite stove coal.

		Coke	Coal
AVERAGE PRESSURES, TEMPERATURES, ETC.			
9. Steam pressure in boiler by gage	lbs.	2.86	4.0
10. Steam pressure in receiver by gage	lbs.	2.0	2.0
11. Temperature of feed water entering boiler	deg.	209	210
12. Temperature of escaping gases leaving boiler	deg.	353	...
13. Force of draft between damper and boiler	in.	.098	.14
14. Percentage of moisture in steam	per cent	0.3	dry
15. Percentage of CO_2 in escaping gases	per cent	7.	...
TOTAL QUANTITIES			
16. Weight of fuel as fired	lbs.	1,142	1,550
17. Moisture in fuel	per cent	8.35	2.92
18. Weight of dry fuel consumed	lbs.	1,047	1,504
19. Weight of ash and refuse	lbs.	109.5	...
20. Percentage of ash and refuse in dry fuel	per cent (a)	10.5	...
21. Weight of water fed to the boiler	lbs.	8,890	12,950
22. Weight of water evaporated corrected for moisture in steam	lbs.	8,862	12,950
23. Equivalent evaporation from and at 212 deg.	lbs.	8,880	12,995

HOURLY QUANTITIES AND RATES			
24. Dry fuel consumed per hour	lbs.	35.	44.7
25. Dry fuel consumed per square foot of grate surface per hour	lbs.	5.18	6.62
26. Water evaporated at 16.7 lbs. absolute pressure per hour	lbs.	296	384
27. Equivalent evaporation per hour from and at 212° F.	lbs.	297	386
28. Equivalent evaporation per hour from and at 212 deg. per sq. ft. of water-heating surface	lbs.	2.9	3.78
CAPACITY			
29. Evaporation per hour from and at 212° F.	lbs.	297	386
30. Feet of radiation served (1 sq. ft. rad. equals 242.6 B.T.U.) sq. ft. rad.	sq. ft. rad.	1,188	1,544
31. Rated capacity in feet of radiation	sq. ft. rad.	75.5	98.2
32. Percentage of rated capacity developed	per cent	75.5	98.2
ECONOMY RESULTS			
33. Water fed per pound of fuel fired	lbs.	7.78	8.36
34. Water evaporated per pound of dry fuel	lbs.	8.47	8.62
35. Equivalent evaporation from and at 212° F. per pound of dry fuel	lbs.	8.5	8.64
36. Equivalent evaporation from and at 212° F. per pound of combustible	lbs.	9.5	...
37. Fuel, as fired, per hour per 1,000 sq. ft. rad.	lbs.	32.2	29.8
38. Dry fuel per hour per 1,000 sq. ft. rad.	lbs.	29.5	29.0
PROXIMATE ANALYSIS OF FUEL			
39. Moisture	per cent	8.35	2.92
40. Volatile matter	per cent	3.58	4.52
41. Fixed carbon	per cent	76.85	82.04
42. Ash	per cent	11.22	10.52
		100.00	100.00
EFFICIENCY			
43. Calorific value of 1 lb. of dry fuel, B.T.U.	B.T.U.	12,670	13,330
44. Calorific value of 1 lb. of combustible, B.T.U.	B.T.U.	14,420	14,960
45. Efficiency of boiler, furnace, and grate	per cent	65.1	62.8
46. Efficiency of boiler and furnace	per cent	...	...
ATTENDANCE			
47. Weight of fuel fired per charge	lbs.	175.	(b) 150-200
48. Weight of fuel fired per charge per square foot of grate surface	lbs.	26.	22, 29
49. Average interval between firings	hrs.	5.	3.3, 4.29
50. Minimum period of operation without attention	hrs.	1.	3.
51. Maximum period of operation without attention	hrs.	5.25	4.67
52. Nature of attention		(c) stopping hole in fire	firing
53. Character of fuel as regards handling, etc.		dusty	clean
54. Character of ash as regards handling, etc.		(d) light and fine	clean
55. Smoke observations		none	none
56. Soot deposits		slight	slight
COST OF EVAPORATION			
57. Cost of fuel per ton of 2,000 lbs. delivered in boiler room		$4.90	$6.75
58. Cost of fuel for serving 1,000 sq. ft. of radiation one hour		$ .079	$ .1003
59. Cost of fuel for evaporating 1,000 lbs. of water from and at 212° F.		$ .316	$ .4012
60. Notes			

a. The ash from ashpit was less than by analysis in the coke test probably because the fire was not shaken down to the starting thickness when the test was closed.

b. Approximately half of the coal test was made firing charges of 150 lbs. each, with charges of 200 lbs. each.

c. There was some tendency for the coke to clinker, but the clinkers were easily broken when a new charge was fired and they did not seem to affect the fire seriously.

d. The ash from the coke was very light and blew off from the shovel and out of the ash-barrel easily.

A Simple Method of Figuring the Economy of Humidity

Under all ordinary conditions where ventilation is carried on to any extent the drop in temperature allowable by artificial humidifying is not enough to conserve sufficient heat on the radiation end to evaporate the required amount of water necessary for the humidifying process. This is particularly true in any case where artificial ventilation or large air leakage is present. To make a statement that humidifying economizes the cost of heating is erroneous in all but a few very exceptional cases.

In comparing costs for a *general* statement on any matter it must be remembered that *average* conditions should be considered and *average* results compared. Now for residence heating it is generally agreed that without humidifying at all the inside air will have a relative humidity (at about 35° F.—average outside winter temperature) of about 40%. The writer has also verified this by actual experiment. Now with 35° outside temperature, 40% inside relative humidity and, say 70° inside temperature we have average conditions attained in residences during winter weather.

It is not believed that many would advocate raising the inside relative humidity to over 60%. If this is taken as a desirable limit the increase in humidity at 70° could not exceed 60% minus 40% or 20%. 8 grains x 20% = 1.6 grains per cubic foot to be added to the air.

According to the "Comfort Zone" chart of Dr. Vernon Hill 70° F. and 40% relative humidity comes just a trifle above the center line of the "zone of comfort" as defined by thousands of experiments. Therefore, at a point the *same* distance above the *same* centerline, but at 60% relative humidity would be shown the temperature which the majority of people would consider as being equivalent with the increased humidity, or 65°. Therefore, the allowable drop for equivalent sensible heating effect would be only 70° — 65°, or 5°.

With 70° inside and 35° outside, the temperature difference is 70°—35°, or 35° and with 65° inside and 35° outside, the temperature difference is 65° — 35°, which equals 30°, or 5° less. Therefore the radiation saving for average conditions would be

35° : 5° : : 100% : x This equals 14 1/3%.

With an average outside temperature during the winter of 35° the average hourly efficiency of 1 sq. ft. of radiator surface would be 250 x 35/70 or 125 B.T.U. This is accomplished by turning the steam in the radiator on and off during mild weather, making a maximum efficiency when "on" of 250 B.T.U. per square foot per hour and an efficiency of zero when "off," the average efficiency being 125 B.T.U., as above stated.

Then a saving of 14 1/3% under average conditions would mean a saving of 125 x 0.14 1/3, or 18 B.T.U. per square foot of radiator surface.

As the living rooms of a residence seldom have an air change of more than once per hour it can easily be computed how many cubic feet of air in the room can be humidified by this saving from 40% to 60% relative humidity.

Each cubic foot under such conditions, as already shown, requires the addition and evaporization of 1.6 grains of water or 1.6/7000 pounds of water which, to evaporate, requires about 1000 B.T.U. per pound, or 1.6/7000 x 1000 = 1.6/7 B.T.U. per cubic foot. Since we have 18 B.T.U. for every square foot of radiation each square foot will take care of 18 ÷ 1.6/7 = 18 x 7/1.6 = 80 cu. ft. approximately of contents.

From this it can be seen that if the ratio of radiator surface to the cubic contents is about 1 to 80 the saving would about equal the loss at one air change per hour, but if the cubic contents exceed this or if the ventilation carried on in cubic feet per hour exceeds this one air change there will be a loss; if, on the other hand the cubic contents is less than 80 cu. ft. to each square foot of radiator surface then there will be a saving. Such ratios, however, are rare and would only apply to small unventilated rooms with comparatively large heat losses.

Typical Details For Hot Water, Steam and Hot Blast Heating

By T. W. REYNOLDS

While the general run of engineering practice follows well-known grooves, there are nevertheless many individual schemes or "kinks" that have been found to work out successfully in practice. Some of these are presented herewith, taken at random from many years of personal experience.

Fig. 1 is a detail of the connections as made for an installation of two expansion tanks. The tanks in this particular case are 30 in. in diameter by 54 in. long and are equipped with a water gauge at one end and a manhole at the other. The tanks are connected by a 4-in. equalizing pipe from the center of which is extended a 3-in. vent to the atmosphere and a 3-in. overflow to the nearest rain-water conductor. It is best, however, to extend the overflow to a point over a slop sink so that it may drip openly and disclose any leakage into the heating system from the automatic water feeder. A 1-in. circulating pipe should be connected to the bottom of the tank and used also as an air vent from the risers. The cold water supply is automatically fed as required through the automatic device which is shown equipped with an equalizing pipe and by-pass, all of 1 in. pipe. The expansion pipe is 2½-in. in size.

In Fig. 2 is shown a good design for a trench curb and covers for use in piping work. Two types of cover are shown. Those of wrought iron should be of the checker pattern. These covers are of ¼-in. wrought-iron plate, either with turned-down edges or reinforced with 1-in. x 1-in. x ⅛-in. angle irons, as shown. The latter cover should have rivets with flush heads. The 2-in. x

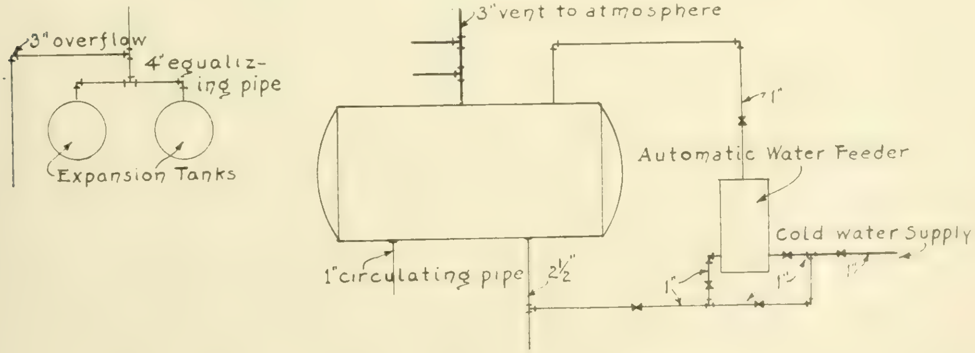


FIG. 1.—TYPICAL EXPANSION TANK CONNECTIONS.

1½-in. x ¼-in. tee irons are anchor-bolted to the concrete every 18 in.

RADIATOR DETAILS.

Fig. 3 shows a fresh air intake suitable for operating rooms. The box coil is shut off from the room by means of glass or marble, except for the opening along the bottom which provides for the recirculation of air when the damper in the intake is partially or wholly closed. A locking device is arranged inside of the room, with a chain extended so as to control a felt-lined and weighted damper in the intake box. The chain and locking device are of nickel-plated brass. Copper louvres are provided and set in the 6-in. x 16-in. galvanized-iron intake box.

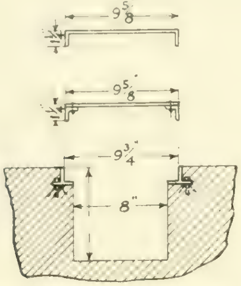


FIG. 2.—DETAIL OF TRENCH CURBS AND COVERS FOR PIPES.

Where the plans call for recessed radiators an arrangement as illustrated in Fig. 4 may frequently be used. The detail shows a recessed radiator, with temperature control valves, enclosed in a lining of No. 22 B. & S. galvanized-iron sheet metal and ½-in. asbestos sheets. An air inlet slot is provided at the bottom and a grille at the top, set so as to be easily removable for cleaning. The legs of the radiator rest upon 2-in. blocks.

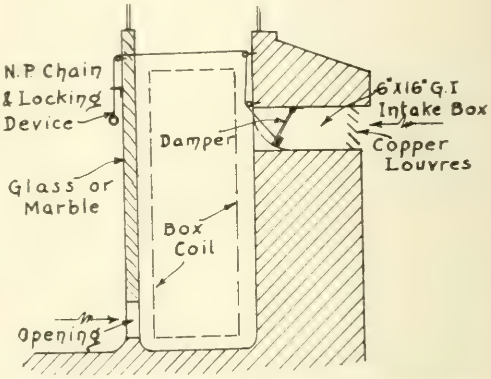


FIG. 3.—DETAIL OF FRESH AIR INTAKE TO RADIATORS.

Speaking of radiator supports, Fig. 5 shows a detail of a cast-iron support for the bottom of radiators. These brackets should be set so that the distance from the floor to the lower edge of the radi-

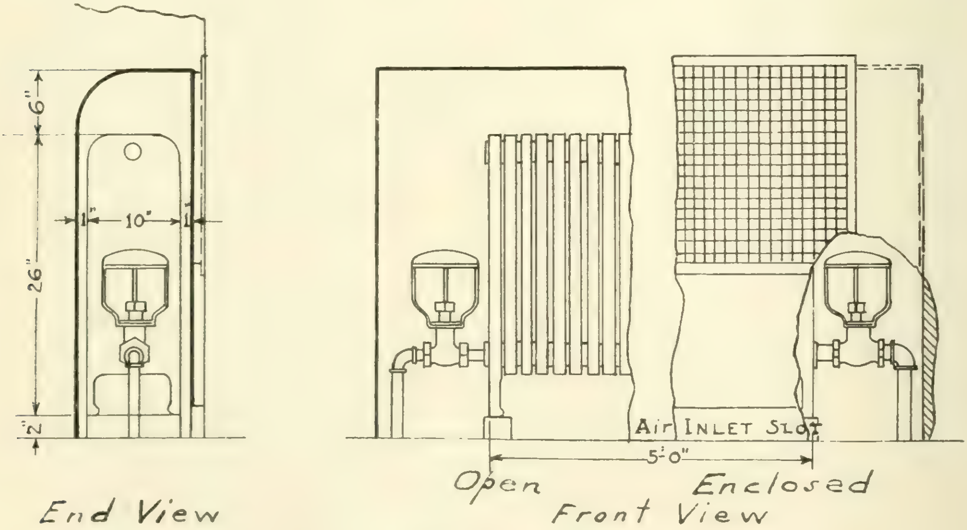


FIG. 4.—ARRANGEMENT OF RECESSED RADIATORS.

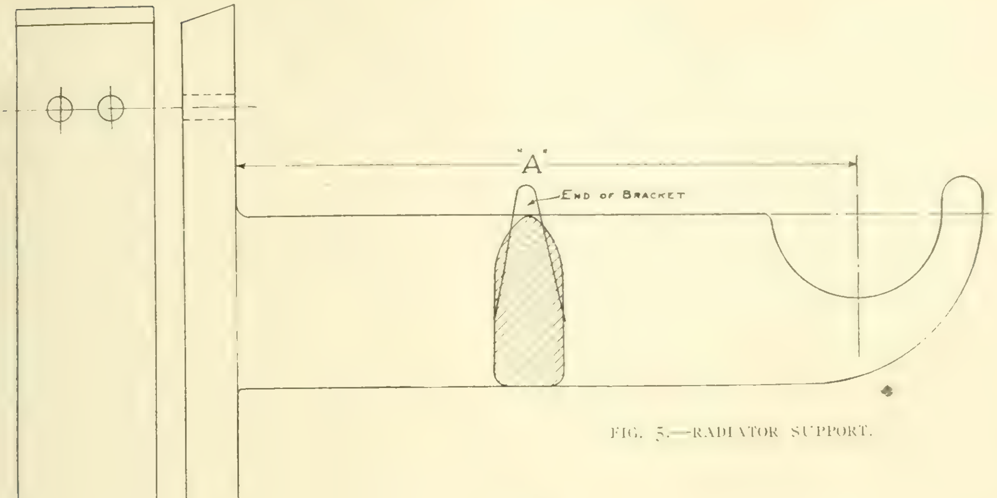


FIG. 5.—RADIATOR SUPPORT.

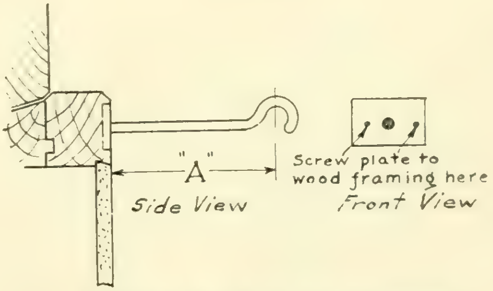


FIG. 6.—HOOK FOR USE AT TOP OF RADIATOR.

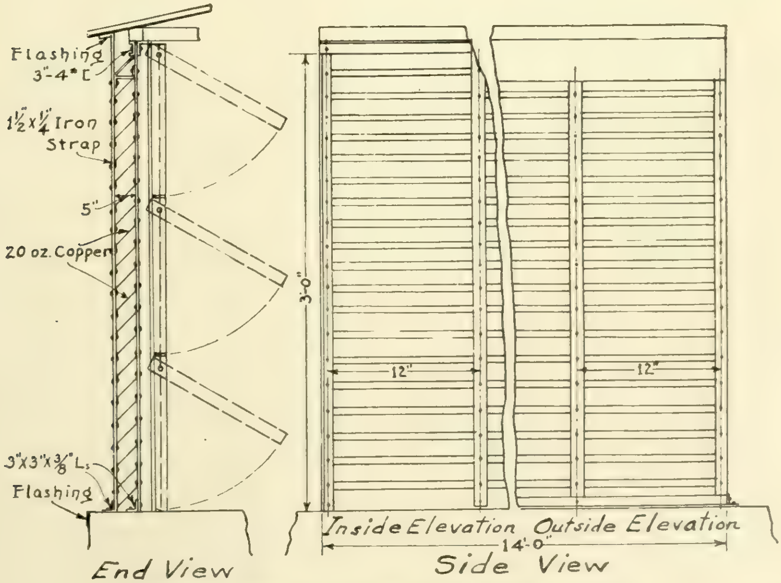


FIG. 7.—DETAIL OF FRESH AIR INLET LOUVRES.

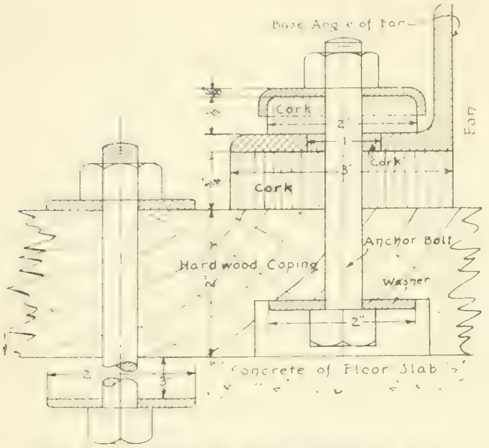


FIG. 8.—METHOD OF SOUND-PROOFING FAN FOUNDATIONS.

ator is 5 in. The distance from the wall to the back edge of the radiator should be 3 in. This determines dimension A. Brackets may be screwed into wooden framing or bolted into masonry so that the edge of the bracket will be flush with the plaster finish of the room. Fig. 6 is a detail of a hook to be used at the top of the radiators.

FAN AND AIR DAMPER DETAILS.

The detail shown in Fig. 7 illustrates a fresh air intake with fixed louvres as designed in connection with the mechanical supply of a ventilating system. Shut-off dampers are also provided, as shown. The louvres are of 20-oz. copper, being riveted to vertical 1½-in. x ¼-in. iron straps. The latter are secured to 3-in. x 3-in. x ⅜-in. angles at the bottom and to 3-in. 4-lb. channels at the top, flashing being used both at top and bottom.

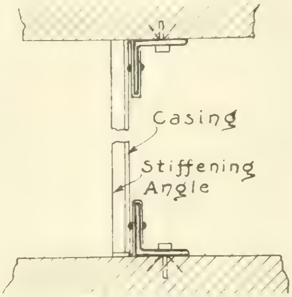


FIG. 9.—CONNECTIONS OF FAN ROOM CASING TO FAN ROOM FLOOR AND CEILING.

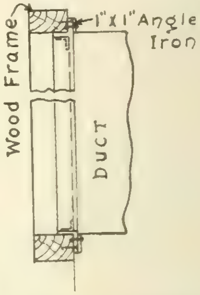


FIG. 10.—METHOD OF FASTENING SHEET METAL FLUES TO VERTICAL PLASTER FLUES.

A good method of sound-proofing fan foundations to prevent the telephonic transmission of sound is illustrated in Fig. 8. To accomplish this it is essential that the fan be isolated from its foundation. It will be noted from the

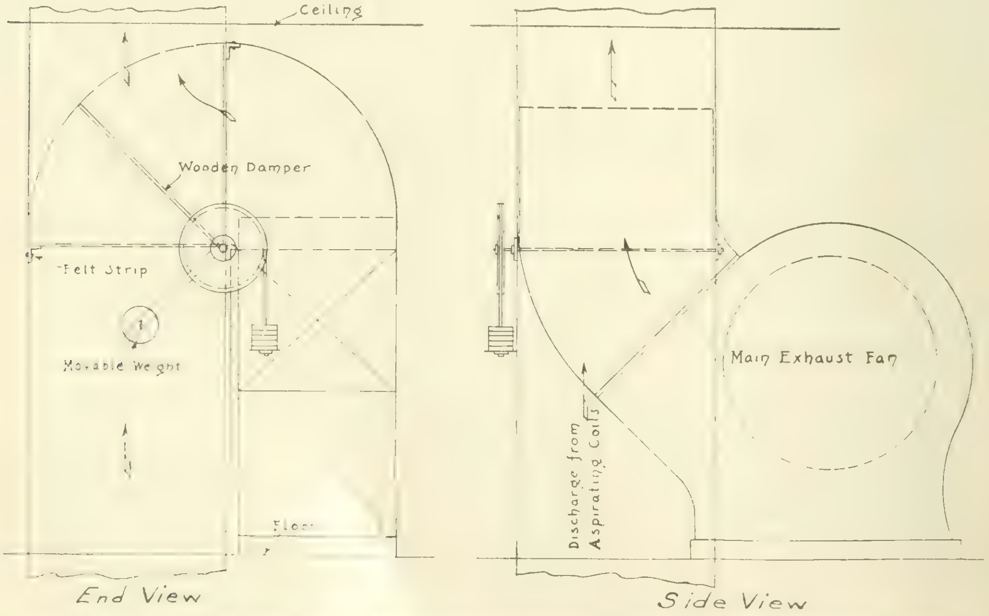
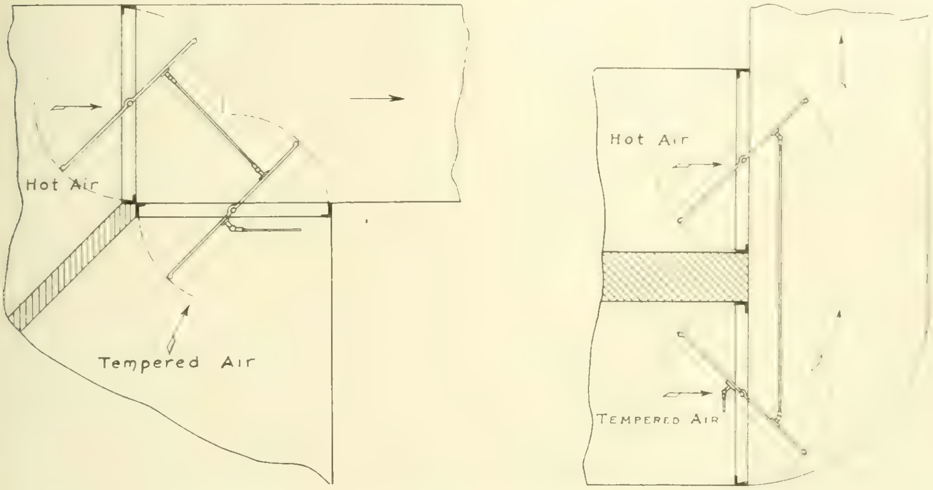


FIG. 11.—DETAIL OF DAMPER BETWEEN DISCHARGE DUCTS FROM FAN AND ASPIRATING COILS.

sketch that the metal of the fan and its base are prevented from coming into contact at any point with its foundation or anchorage bolts. Cork is the material used, together with a hardwood coping, bolted in turn to a steel beam or to the concrete of the floor slab.



FIGS. 12 AND 13.—TYPICAL DAMPER SETTINGS AND CONSTRUCTION.

In making sheet metal connections in fan rooms, a satisfactory method is shown in Fig. 9, indicating how the fan-room casing is connected to the fan-room floor and ceiling. Stiffening angles are used, with 2-in. x 2-in. x 3/16-in. angle-iron anchors bolted to floor and ceiling. The connections between the latter and the angle iron are made tight by means of cement grout or asbestos wicking. Fig. 10 shows a method of fastening sheet metal flues to vertical plaster flues so as to make an air-tight joint.

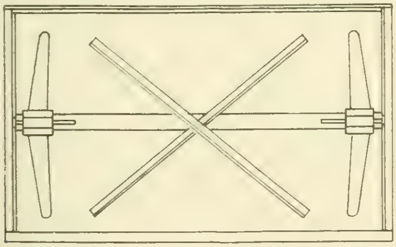


FIG. 14.—DAMPER, WITH REINFORCING STRIPS.

Coming to the subject of dampers, Fig. 11 illustrates a detail of a damper between the discharge ducts from the fan and aspirating coils. The damper is weighted, as shown and set between two discharge ducts, one from the fan and the other from the aspirating coils. The damper is arranged so as to close the connection from the aspirating coils while the fan is running. When the fan stops, the connection to the discharge duct is closed and ventilation by aspiration only is assured. Wood is used in the construction of the damper in the form of two ¾-in. boards covered with tin and arranged so as to close on felt strips. Adjustments may be made by means of the movable weights on the lever attached to the damper, the number of weights acting on the wheel being as required.

Typical mixing damper settings for hot and tempered air are illustrated in Figs. 12 and 13, while Fig. 14 shows

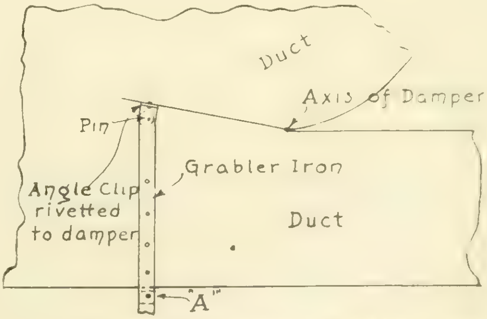


FIG. 15.—METHOD OF FASTENING AIR-[illegible]TING DAMPERS IN POSITION.

good practice for damper construction. The latter sketch shows the reinforcing strips used, while the two former the rolled-edge construction is followed, which serves to protect and stiffen the dampers.

The fastening of air regulating dampers in position is also an item of varying practice. A convenient method of doing this, where the dampers are to be placed in ventilating ducts, is shown in Fig. 15. When the correct position of a damper has been found, it can be bolted at the point A, and the end of the grabler iron sawed off. Angle clips are riveted, one to the duct at the point A and another to the damper at the point shown.

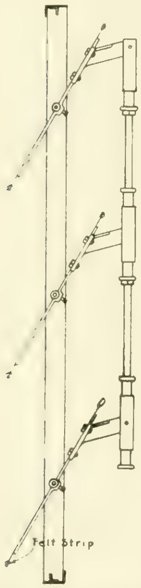


FIG. 16.—DESIGN FOR THREE-BLADE LOUVRE DAMPER.

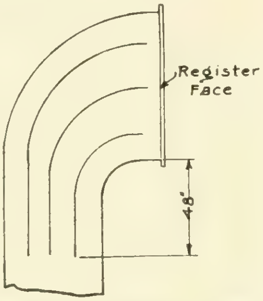


FIG. 17.—GENERAL ARRANGEMENT OF INTERNAL DIFFUSERS.

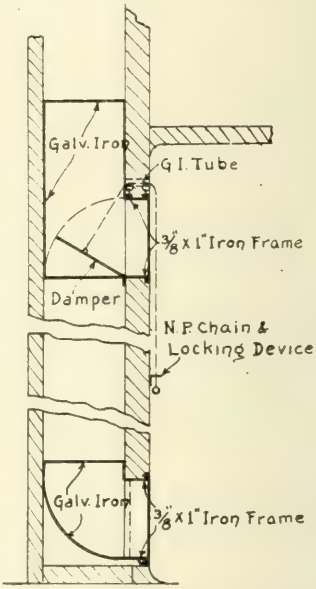


FIG. 18.—SHEET METAL CONNECTIONS TO PLASTER FLUES.

A good design for a three-blade louvre damper used as a fresh air intake is illustrated in Fig. 16. The frame is made up of a 2-in. x 5/8-in. channel weighing 2 lbs. per foot, the operating mechanism being constructed of 1/8-in. pipe using right and left-hand fittings. Intermediate connections are tapped and threaded 7/16 in., 20 R, to L. The blades are of No. 22 or 24 gauge galvanized-iron, according to size and are braced with 5/8-in. x 1/4-in. bar iron or 1-in. x 5/8-in. x 1/8-in. angle iron (long leg up) according to area and proportions.

Blades which are long enough to be inclined so as to sag should have angle-iron supports running lengthwise. The edges of the blades are weighted so as to prevent them from sticking and buckling. This method also serves to stiffen the blades and make them easily movable. Felt strips are used as shown. The construction as here outlined provides for substantial louvres, suitable for steady operation and permanency.

Finally, in the matter of register faces the accompanying sketches, Figs. 17 and 18, may offer useful suggestions. Fig. 17 shows a general arrangement of diffusers as extended back into the ducts from the register faces. Fig. 18 shows a typical sheet-metal connection to plaster flues from top and bottom room-inlets and outlets. The upper or supply inlet has its flue extended above the register face for a short distance in order to cushion the air.

A Practical Plan of Engineering Co-operation

By F. H. NEVELL.

Head of Department of Civil Engineering, University of Illinois.

From an Address before the Cleveland Engineering Society.

Out of the white heat of the devouring conflict in Europe a new world is emerging. We are being included in that new world, and are in the midst of great changes in methods and ideals. As engineers, as "men of ingenuity," we must have the clear vision to see what is coming, to recognize the new conditions and to maintain a leadership in the larger activities for the common good.

The traditional engineer is accused of being conservative, of taking the safe side, of assuming a factor of safety disproportionately large and of proceeding with a caution which verges upon fear, especially in connection with conditions outside of his immediate line of experience. In spite of this the engineers as a body are awakening.

The conspicuous outcome of these changes is a larger recognition of human agencies in engineering work. In the past the engineer has thought almost wholly in terms of materials; he is now appreciating more than before that the efficiency of his machines is dependent not only upon the quality of the steel and speed with which the tool operates, but even more than this upon the spirit of the man who is behind the tool.

We have been studying and conducting researches into the methods of securing the highest degree of efficiency out of the machine, overlooking the fact that with the very best equipment and the finest organization, we cannot attain the maximum result unless we have the men with us, unless they feel that they are not merely part of the machine but are being treated as men and are being afforded an opportunity to live their lives according to their highest ideals. The spirit of the men counts for more than the design of the machine.

RESTLESSNESS AMONG ENGINEERS.

There is a restlessness throughout the great body of engineers in this country due to the fact that they dimly realize that they are not well placed. This restlessness is necessarily an accompaniment of the change in conditions and in ideals. Out of this restlessness is coming a discussion of the broad question as to where the engineer stands in relation to the rest of the world. Is he performing his full part? Is he living up to the best that is within him? Especially are the organizations to which he belongs doing their best or are they simply moribund relics, outgrown shells of former habitations? Are they cramping the spirit of progress or are they sufficiently elastic to be adapted to our rapidly growing needs, especially those of wider human relations?

To answer these questions we must get together and talk them over. It is not possible for any one man or group of men to survey the whole field and to decide as to whether the engineers and their associations are following the more direct path in their leadership in the world's material progress. There must be an exchange of ideas, a co-operation, a working together of many minds and of many scattered forces.

An engineering society is simply an individual grown large with indefinite length of life. It is subject to very much the same laws, and if the individual finds that it strengthens and broadens him and makes him a better man in the community to get together with his neighbors and to exchange experiences, so, in like manner, the society is strengthened and improved in the efficiency of its work by meeting with other societies of like aims. Efforts are stimulated, new ideas brought forward and the progress is increased in geometrical ratio as the number of these organizations which get together is increased.

It is, of course, impracticable for each society as a whole to meet with a similar society from a neighboring city or State, but excellent results are found to flow from an exchange of visits of a few delegates and even greater from a still wider exchange of experience in the case of delegates from organizations from many cities and States.

METHODS OF ENGINEERING SOCIETIES UNDERGOING CHANGE.

The stated object of an engineering association is usually the advancement of engineering knowledge and practice and the maintenance of a high professional standard among its members. Each new society at its birth has adopted largely the forms and methods of the older bodies, often unconsciously copying precedents which the more mature society would be glad to drop and overlooking the unrecorded improvements which have taken place. For example, when the first engineering organizations were formed, there was demand for the publication of technical papers; many of the associations thus practically became publishing houses for material much of which now might be printed to better advantage elsewhere. Their energies are often being expended in uneconomical ways.

The growth of the technical press, with its machinery for presenting quickly and concisely to the engineering profession and to the public at large the latest discoveries and the most recent achievements, has made unnecessary much of the work which was originally performed by engineering societies. Nevertheless, many of our newer associations persist in following along the old beaten track of publishing papers, not lifting their eyes from the ground and seeing the great neglected needs around them. Much of the money thus misused might better be expended in getting men together to discuss the present status and tendencies of affairs and to consider how best to help each other and the world in general, incidentally promoting the social features which are so vital in all human affairs. You as an organization are leading in this better direction, so that it is only necessary to add that your example has been of great value to other organizations.

MOST SOCIETY MEMBERS NOT STRICTLY PROFESSIONAL MEN.

The moment we recognize clearly the fact that the men who join the engineering societies as yet are not professional men although looking forward to that condition, then it follows that we must modify our organization and methods to accomplish the largest good to the greatest number. With this condition in mind, namely, that, while some may be professional men in the strict sense of the word, yet the great majority, particularly of our younger men, are not professional, but are more of the nature of wage earners, we must look around us and see what similar organizations of other men are doing. We must try to help each other by an exchange of ideas, by an exchange of experience, so that we as an organization may perform our full duty, not only to our own members, but to the public in general.

EMPLOYMENT.

The first thing, the thing that all must have, is a job. We must have employment. We cannot all start in life as professional men, picking out our work and stating what our compensation shall be. We have got to grow up to that status. In the meantime we must live, and if there is any one thing which an engineering society has as a duty to its members, it is to assist them in securing employment. If you stop to consider it, practicaly every one of us at some time or another is out of a job.

More than that, as we are out of a job perhaps only once or twice in a decade, we are of all people the most helpless when we are out of work. The highly trained and educated man is peculiarly unfortunate under these conditions. The mechanic is out of work more frequently. His comrades recognize this fact and do their part. The machinery of modern industry, while crude and inefficient in the matter of employment, does operate after a fashion for his benefit. He knows how to go about to get work, and it is no disgrace to him to be out of employment. Every one of us, when we are out, feel that it is a disgrace to let the fact be known. We are dazed. And if there is any one thing that the organization of our associates should feel incumbent upon them, it is to help the fellow member to do the thing which he cannot do himself, and to make it possible for him to get employment at proper compensation just as quickly as he can.

It is a most pitiable condition to see

such men accepting mere living wages, men of high ability, high attainment, because of an inherent modesty, a condition cultivated by the engineering ideals. All should unite in intelligent, well-directed consideration as to how to help our fellow member to be better treated when the critical time comes. We can say things for him that he cannot say for himself and that he cannot ask us to say; it is one of our duties as men and members to look into employment systems as we never have in the past, because as has been said, the times have changed, and the conditions of employment now and in the future are getting more and more stringent. This is particularly the case for some of the older men. For them the line is often drawn rigidly at forty-five years of age. Any man over that line is not employed. It is a cruel and often unnecessary situation. This and other injustices can be cured, if at all, only by the united effort of an organization of this kind and by your co-operating with other organizations in similar work throughout the country.

Every day that one of the men who make up the rank and file of an engineering society is out of work is a loss not merely to him and his family, but also to the community. It is a duty as yet only vaguely recognized on the part of the society to see to it that the brother member secures congenial employment at the earliest practicable date. The traditions of the engineering profession, and the unwritten laws seem to penalize the unfortunate engineer who is not immediately employed on the conclusion of one enterprise or on the sudden termination of his former connections. Individual and professional pride prevent him from going outside of the circle of his people. To do this we must propagate throughout the country the kind of publicity which enables the public to know and appreciate what has been done, and to give to the engineer the standing which men of brains deserve, and which they do not get if they do not let the world know what their individual members are doing for the public service and for the up-building of all humanity.

Professional men shy at the word publicity and "go up into the air" at the idea of advertising. The older professions frown upon self-sought publicity. Nevertheless, they have seen to it that the public is at all times kept informed of their activities not as individuals, but as professional men ministering to the needs of humanity.

Many engineers have not been able to clearly distinguish betwen self-seeking advertisng and the proper and necesary publicity or diffusion of information regarding engineering achievements. They have assumed that publicity meant the advertising of some one man or some scheme for personal advancement. They have overloked the fact that the engineers as a whole cannot perform their full duty to the community until the community is well informed concerning what has been done and, more than this, what can be done. The public uninformed little knows of the infinite variety of devices perfected by the engineer which have improved health, comfort and prosperity. While the individual engineer may not properly exploit his own performance, yet the association of which he is a member has a duty to itself, to the public and to the members to put out clearly and frequently statements acceptable to the daily press which systematically bring about the proper appreciation of engineering work.

BETTER LAWS.

The third line in which our engineering organizations should co-operate is that which will bring about improved civic conditions, through better laws. In this we have held back. We have thought that the law was something with which a respectable engineer should have nothing to do. In a letter recently received from a distinguished engineer, a very charming man, the statement was made in effect: "We engineers should not trespass on the domain of the law maker." That sounds rather queer, think it over—the domain of the law maker. Who is the ideal law maker? Surely not the lawyer. His business is to interpret the laws, to find out what the law is and to stay within it. He has rarely the constructive imagination to devise good laws. It is true that the majority of our law makers are lawyers; and also that our lawyer-made laws are something to which we do not always point with pride.

Who is the law maker? The law maker should be the man of sound information coupled with vision; if any man is a law maker by right, it should be the engineer; instead of encroaching upon the domain of the law maker, it is the proper domain of the engineer to suggest and to outline future laws not on the basis of what they have been, but what they should be, as determined by the careful investigation of educated men who are studying the facts and not the theory which existed in the minds of the ancients.

Society can make little progress until the man-made laws restricting progress are revised to meet the exigencies of modern changing conditions. In this work the engineer has been singularly remiss. His thoughts have run almost wholly upon materials and he has kept aloof from the human relationships which now seem to be so vital in the full use of these materials. The ordinances of the city, the acts of county commissioners, the laws of the State and of the nation, have been framed mainly by men who have not had the broad vision which should be possessed by the engineer.

ETHICS.

Our professional men, the men who devote their lives to the highest good of the community and whose greatest reward is not in their pay but in the performance of duties to the commonwealth must be protected from the cheap man, the bungler, the charlatan, the quack, the man who is trying to commercialize the profession. To do this we must have and must enforce an ethical code.

Ethics is a word which has been too little heard at meetings of engineers. We know that there is such a thing and that in the profession of law and medicine the local organizations are frequently discussing and applying the principles of their ethical codes. They have found it absolutely essential to protect the man who puts the practice above the pay from the person who would drag him down and literally starve him out. By experience they have learned that the syster, and the chalatan easily get the ear of the public and if not restrained will reduce the profession to a mere trade. The highly skilled man devoted to his profession in many lines would be practically unknown, were it not for the fact that the horde of cheap men were held in check by the enforcement of a firm code of ethics.

"It is not enough to set forth a code of ethics as a lamp to straying feet. It is necessary to make it worth while for wobbly practitioners to live up to the code."

"Mere moral suasion no more suffices to keep the professions straight than public opinion suffices to keep the peace. In either case, tribunals and punishment are necessary. The good in each of the professions ought to be organized in order to pursue and harry the bad."*

As has already been said, ethics has not been enough considered in our societies. We have assumed that the average engineer is an honest man or he would not be an engineer, and we have permitted the consideration of ethics to drop in the background. There is no one thing on which the engineer can cooperate more effectively to the profession than in the consideration of ethics, the discusison of codes and the enforcement of these by local associations. You know your local conditions, you know your local men; and if any man falls below the proper standard, he should be tried by the men of his own profession on the ground, who can give to him the justice to which he is entitled. One of the things that we have missed, and one that we must take up in the future to meet the changing conditions is the handling of the ethics, in a brave, clear, clean way, to protect the men of high ideals from the encroachment of the less scrupulous men.

NATIONAL SOCIETIES.

To bring these things about, you cannot act alone or try uncertain experiments. To attain certain results, you must have behind you the profession in general, and the backing of other local organizations.

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* See "The Making of the Professions," by Edward Alsworth Ross, in the International Journal of Ethics, October, 1916, pages 67-81.

In what has been said reference has been had mainly to the city or local organizations. Each of you as engineers has this duty of building up and strengthing your own local organization. In the same way the engineers resident in every other city or locality have a similar duty. In doing so, however, they should not overlook the claim of the great national organizations with headquarters in New York. They have their distinct place in outlining and maintaining the ethics of the profession and in setting standards. Each of us as a citizen of our municipality and state and also a citizen of the United States has certain distinct duties. So as engineers, while our immediate interest lies around us, yet we must not forget the fact that we are, or should be, a part of the great national body.

First build up and help build up a local engineering society in each and every locality where a score or more of engineers are gathered together, assist those men to organize, to look after the local questions of engineering in general and also of employment, of legislation, of proper education of the public, and of enforcement of ethics. At the same time, each of us as a citizen of the larger world represented by the great national technical societies, after having discharged our duties to the local society, should try to join one or another of the national organizations, and, more than that, should endeavor to bring those together in unity of action, perhaps not in actual coalescence, but in unity of ideals, selecting standards for our local societies.

Recent Progress in the Use of Gas for House Heating

With Data Showing Amount of Gas Required to Heat a Given Building.

An interesting compilation of data has recently been made by a committee of the American Gas Institute on the subject of present gas heating systems. George S. Barrows, manager of the gas heating department of the general Fire Extinguisher Co., Providence, R. I., is chairman of the committee.

The report deals first with hot water heating systems using gas exclusively. Records of eight such systems are presented. All are residences. The total cost of gas fuel for one season was $268, $234, $281, $204, $632, $493, $120 and $131, respectively. The estimated cost of coal for the same buildings is given as $180, $187, $225, $240, $502, $502 and $120, respectively, a comparison with the last building being omitted.

The estimate as to the coal cost was based upon 2¾ tons being required per 100 sq. ft. of radiation per season.

The next group includes four buildings equipped with steam heating systems, using gas exclusively. The gas heating costs ran as follows: $506, $1,093, $359 and $169, respectively, as compared with an estimated cost, using coal, of $277, $682 and $112, respectively, figures for the last building being omitted. It will be noted that in each case the cost of gas fuel is considerably in excess of that estimated for coal, although this difference, it is pointed out, would be decreased by the addition of labor charges, etc.

HOT AIR SYSTEMS.

Data were secured on two systems using gas-fired hot air furnaces. Here the total cost of gas fuel was $253 and $348, respectively, as compared with an estimated coal cost of $300, in each case. The price of gas in these cases was 54 and 53 cents, per 1,000 cu. ft., respectively.

GAS STEAM RADIATORS.

Under this heading a number of cases are cited of operation results with gas steam radiator installations. In these tests a heating effect for a season per 100 cu. ft. was secured at a cost as low as 5½ cents, although the average was generally about 48 cents. With portable heaters similar results were secured.

The report then took up the Rector

system. It was stated that many of the difficulties which have been encountered in the use of the Rector system are due, in large part, to poor mechanical construction and lack of organization on the part of its backers. In spite of these odds, states the report, there are many satisfied owners of Rector installations. A very successful manufacturing and construction organization has recently lent its hand in improving and marketing this appliance and it is likely observes the report, that the mechanical faults shortly will be remedied. According to the records of several Rector systems the total cost of gas fuel in one case was $406 compared with a previous coal fuel cost of $280; and in another case $451 as compared with a previous coal fuel cost of $225.

AMOUNT OF GAS REQUIRED TO HEAT A GIVEN BUILDING.

From the data obtained the committee arranged a summary table, which is given herewith, showing the amount of gas required to heat a given building, or part of a building, under certain known conditions. In making up this table only such data as pertained to systems in use for one or more complete heating seasons were used. These data have been separated with reference to the type of heating plant, building occupancy and the locality. All figures relative to gas consumption are in terms of cubic feet of gas required per heating season per 100 cu. ft. of building contents heated. When more than one installation of a kind occurs in the same locality and in the same class of building, the total number of such cases used in working out the average fuel requirements, together with the maximum and minimum fuel requirements of the group, are tabulated. In some of these cases it will be seen there is only a small percentage of variation between the maximum and minimum fuel requirements.

An important section of the report is devoted to heating systems using gas fuel as an auxiliary. In this connection it is pointed out that the attempt to adapt gas burners to existing coal heaters can have but little commercial success and in many instances will, no doubt, prove costly to the gas company. The committee carefully considered the use of heat regulators in connection with gas-fired heaters and believes that they should be recommended in every case for their convenience and utility. It is probable, adds the report, that but little actual saving in gas, if any, will result from the use of heat regulators, but they will materially improve the service.

HOW THE GAS COMPANIES ARE PUSHING AUXILIARY HOUSE HEATING APPARATUS.

The following information for canvassers is used by one large gas company:

The gas hot water heater and gas steam heater will heat a house satisfactorily with but little more cost than coal during the early fall and late spring months. Some people are so pleased with the cleanliness and convenience of a gas heating equipment that they continue its use during the entire winter, willingly paying the extra cost over coal for the comfort of the gas heating system.

As a rule the gas company should not advise the use of gas central heating plants for the entire house in winter months, as this work can be done then at less cost by the regular coal furnaces, but the small extra cost of gas heating in the early fall and late spring (sometimes it is cheaper than coal) is well worth paying to take advantage of the cleanliness, comfort and easily controlled heat given by gas-water, and-steam "central" heating plants.

It is possible, by use of a thermostat, to carry an even temperature in a house with the minimum cost.

Every one knows the difficulty, in early fall and late spring, of keeping a fire constantly in the coal heater and at the same time keeping the house comfortable. It is too hot during the day and damp and cold at night. This unpleasant, unhealthful condition is entirely eliminated by the use of a gas-fired steam boiler or water heater. Many of the annoying colds due to wide variations in house temperatures, will be avoided by the even, uniform heat of a gas fired plant controlled automatically by a thermostat.

In this case the gas company recom-

GAS REQUIRED TO HEAT VARIOUS TYPES OF BUILDINGS.

(Figures Show Cubic Feet of Gas Used per Heating Season per 100 Cu. Ft. of Building Contents Heated.)

Type system. Max., Min., and Aver., c. ft. gas required per season per 100 c. ft. contents		Residences								Small Ap'rt-ments	Small Stores.		Offices.	Tel. & Tel. & R. R. Ticket Offices.	Ch'es.
		Baltimore, Md.	Brooklyn, N. Y.	Newark, N. J.	Rochester, N. Y.	Savannah, Ga.	St. Louis, Mo.	Toronto, Can.	Worcester, Mass.	Toronto, Can.	Newburgh, N. Y.	Savannah, Ga.	Savannah, Ga.	Savannah, Ga.	Savannah, Ga.
Hot Water	No. cases						3								
	Max.						1710								
	Min.						1140								
	Aver.						1328								
Steam	No. cases						2		1						
	Max.						1655		2513						
	Min.						1500		2513						
	Aver.						1602		2513						
Hot Air	No. cases						2								
	Max.						1233								
	Min.						860								
	Aver.						1043								
Gas Steam Radiators	No. cases			2							5	4	3	2	2
	Max.			2240							1805	154½	122	491	87
	Min.			2065							703	70	117	424	50
	Aver.			2158							644	116	117½	445½	58½
Portable	No. cases		1			1						2			
	Max.		700			393						127			
	Min.		700			393						124½			
	Aver.		700			393						125			
Rector	No. cases	2			1			1	1	4					
	Max.				929			2465	1176	2124					
	Min.				929			2465	1176	780					
	Aver.				929			2465	1176	1488					

mends the use of a specified type of gas steam boilers and gas water heaters. The heaters are of ample capacity to furnish the necessary heat to take care of the radiation surface for which they are listed. The coils are copper—and are large in diameter, insuring rapid circulation and the interior is smooth, to insure freedom from obstruction. The coils are arranged to have the steam and hot water leave the heater at the hottest part of the flame, insuring highest temperature and efficiency.

The burners are well made, equipped safety door which shuts off the gas supply when opened, making it free from any danger in lighting. The coils are readily removable and can be plugged with ordinary screw plugs when temporarily removed, thus continuing the heater in operation.

The burners are well made, equipped with easily-adjustable outside air mixers and removable brass tops covered with gauze to prevent flashing and insure perfect combustion.

(Here is given some detail information regarding heater sizes, tappings, etc.)

This gas company installs a thermostat equipped with a reliable eight-day clock, the mechanism being so arranged that at night the thermostat pointer is moved back automatically to the night temperature and again in the morning, at the predetermined hour, is moved forward to the day temperature. As the hand set at the predetermined hour is brought to the top by the revolving dial, the hand comes in contact with a small lever, tripping a mechanism which moves the thermostat pointer entirely independent of the clock. The lever resumes its original position and is ready for the next operation.

The time set is changed readily. The range of the automatic throw is adjustable both backwards and forwards. The thermostat pointer can be moved at any time entirely independent of the clock mechanism without affecting the automatic action.

The gas company will obtain estimates from steam fitters for installing a heater on plans furnished by the gas company and will submit steam fitter's bid for installation to the prospect, together with an estimate of the cost of the heater and thermostat. In each case the agent will write a letter definitely stating the cost and terms so that no misunderstanding can arise.

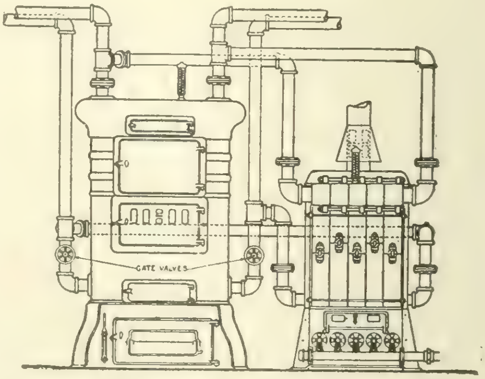
The gas company will handle the entire contract if so desired, paying the steam fitter upon completion and acceptance of the work, and will collect from the customer in twelve monthly installments.

The gas company will put the heater in on thirty days' trial and will remove the heater if unsatisfactory, allowing the customer the full value of the heater and thermostat. The purchaser in this case would pay only the steam fitter's installation costs.

The gas company will install a separate meter to be read daily during the trial period.

HOUSE HEATING WITH GAS IN BALTIMORE.

The report concludes with a report on the use of gas for house heating purposes in Baltimore. Baltimore now has a gas rate so low that it is entirely practical for its citizens to make use of this fuel at a very moderate cost. With the establishment of a secondary rate of 35 cents for 1,000 cu. ft. for excess domestic consumption, the industrial fuel department of the Consolidated Company began an extensive series of tests and investigations covering every phase of house heating. Houses were rented and used for experimental purposes with a



METHOD OF INSTALLING AUXILIARY GAS HEATER WHEN OWNER DESIRES TO RETAIN HIS COAL HEATER. EITHER ONE MAY BE USED INDEPENDENTLY OF THE OTHER.

view of establishing the cost of heating various types of houses with different heating systems. Various makes and designs of furnaces, radiators, burners and thermostats were tested in actual use and those best adapted for the purpose were selected and standardized for installation.

In the case of a house already provided with a coal furnace, there are three methods of procedure. The coal furnace may be removed and a gas furnace set in its place, a gas furnace may be placed beside the coal furnace and connected to the system so that either may be operated, or the coal furnace may be converted to the use of gas by installing suitable burners in it. The first two methods, it was pointed out, while representing a greater initial outlay, are also more efficient and satisfactory in operation. The company is advising its customers, whenever possible, to install a new furnace designed and built to burn gas, rather than to convert a coal furnace into a gas furnace.

Baltimore, it is stated, is the first city to have a rate low enough to make artificial gas available for heating homes at a moderate cost.

How to Fire a Furnace With Soft Coal.

Some timely points on the proper method of firing a furnace have been drawn up by the engineering extension department of the Iowa State College, and are given herewith:

In firing a furnace, remember that the main part of the air supply should come through and not over the fuel bed. Hence, do not leave the damper in the firing door open at all times.

Open it for a short time after a fresh charge is fired to burn gases. To leave it open after coal has burned to coke is wasteful.

Fire a fresh charge so it covers not only the whole fuel bed, but just the front of the furnace, thus leaving red coals at the rear uncovered so air may come through and help burn the gases.

Check the fire by opening the check damper in smoke pipe or by closing front damper or both and not by opening the furnace door or damper in door.

Shake regularly night and morning. In mild weather shaking once a day may be enough.

Keep the top of the fire level with the bottom of the firing door, or nearly so, at all times.

In cold weather the depth of the ashes beneath the fire should be less than in warm weather. In other words, vary the thickness of the fire with the weather, not by raising and lowering the top of the fire, but the bottom.

Remove ashes daily. Accumulated under the grates they spoil the draft and burn out the grates.

To fix the fire for the night, place the fresh charge on the fuel bed and allow to burn up with drafts open for a short time (not too long). Then close furnace for the night. In order to handle a furnace this way it must be tight.

COMPARATIVE EFFECTIVENESS OF DIFFERENT TYPES OF HEATERS.

House heating fuel tests, recently conducted by the engineering experiment station at Ames, present some interesting comparisons of various fuels and methods of heating.

For quick heat and fuel economy, the hot air furnace leads, although it may fail to distribute heat evenly in a house of more than one story. Hot water heat is economical, but slow to warm up a room, starting from a new fire; steam heat is fairly quick, but fuel cost is commonly high. It is suitable for a building of many rooms or under conditions which require steam in the radiators continuously.

Recent jumps in prices of certain fuels may, in some places, reverse the order of most economical fuels to buy. The following list, based on the tests made with a common type of steam furnace, does not attempt to fix fair prices, but gives approximate values per ton, compared with Iowa coals at $4 to $5:

Iowa lump coals	$4.00 to $5.00
Illinois lump coals	$5.00 to $6.00
Eastern soft coals	$5.50 to $7.50
Egg size hard coal	$6.25 to $7.25
Gas-house coal	$6.00 to $7.00

Domestic soft coals will yield a better actual heating value when more of the volatile gases are actually consumed. An underfed or down draft furnace or a very high furnace temperature may produce generally the desired result. A hot air furnace generally permits the highest, a hot water furnace the lowest fire box temperature.

THE HEATING AND VENTILATING MAGAZINE
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THE HEATING AND VENTILATING MAGAZINE takes pride in being enrolled among the three hundred trade journals, representing practically every industry in the country, that have pledged their services to the Government for any assistance they can render. Our bit will be done by giving publicity, both through our reading and advertising columns, to any measures which the Government desires to bring to public attention, and more particularly to the attention of engineers.

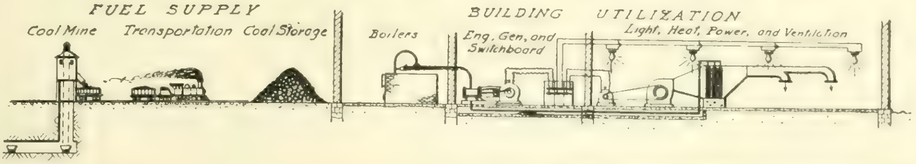
Speaking professionally, it is being asked what opportunities heating engineers will have for serving the Government. They will undoubtedly have many opportunities. With the adoption of the plan for raising an army of 2,000,000 men, the matter of barracks alone will involve a tremendous amount of work in connection with their mechanical equipment. Hospital buildings will also constitute an important item and inquiries have already been received as to the most practicable methods for heating temporary or portable hospital units. Then there is the equipping of additional industrial buildings and munition plants to turn out the vast supplies provided for in the stupendous $7,000,000,000 bond issue already authorized by Congress and which, it is stated, takes care only of the first year of preparation.

The trend of events has already gained such a momentum that military preparedness on an adequate scale is bound to become an accomplished fact, irrespective of the course of the war in Europe. America is awake and heating engineers, we are confident, will stand as a unit in helping the Government to vitalize at the earliest possible moment the incalculable resources and energy that are ours to command.

◆

IN an effort to make THE HEATING AND VENTILATING MAGAZINE of wider usefulness to its readers and without departing in the least from its settled policy of confining its columns to matters of direct interest to the heating and ventilating profession, we are pleased to announce the inauguration of two new departments, one on "Air Cooling and Refrigeration" and the other on "Power Plant Equipment." It has been recognized for some time that the scope of the up-to-date heating engineer is extending more and more in these directions, but one difficulty has been to conduct such departments without infringing on the field already adequately covered by the refrigerating and power plant journals. This will be accomplished, in a large measure, by confining the new departments to matters of design and, further, to designs that have a close connection with the general heating and ventilation scheme. Readers are invited to submit problems or notes of interest in connection with air cooling, refrigerating or power plant work for discussion in these departments.

POWER PLANT ENGINEERING



Smaller Power Plants for Single and Group Buildings

The growing importance of ventilation, combined with more exacting requirements for artificial heating, has made it necessary for the heating and ventilating engineer to expand beyond the limits of his original field and to assume a larger responsibility. He must not only know how to use steam after it is generated, but he must also understand the problem of its generation and how most economically to procure the necessary power to operate his heating and ventilating fans, air washers, pumps, etc. As soon as such a step is admitted, he is immediately involved in power plant construction and also, to a greater or less extent, in electric current production.

In other words, the heating and ventilating engineer is being rapidly projected into the mechanical equipment field. And this is a logical development, because it is evident that as a rule the interests of a building are going to be much better served when its equipment is designed by one competent engineer and its apparatus co-ordinated throughout, than when the various parts are divided between the architect and three or four separate engineers whose work may at times conflict.

In recognition of this condition a new department, to be devoted to "Power Plant Engineering," with special reference to the smaller power plant, has been inaugurated this month in THE HEATING AND VENTILATING MAGAZINE. In general, the new department will deal with the points involved in the design of power plants for single and group building installations.

ENGINEER SHOULD BE JUDGE OF ADVISABILITY OF INDEPENDENT PLANT.

It is a generally recognized fact that the larger the power load of a building and the greater the number of hours per diem that this load (or the larger portion of it) is carried the greater will be the economy resulting from the installation of a power plant. It is not the province of the engineer to advocate a building plant under any and all conditions, however; on the contrary he must be the court to determine for the owner the advisability and saving possible, or the inadvisability and loss resulting, if a power plant should be installed. True, in many cases, these estimates must, to a large extent, be based more or less on supposed conditions. No man can say just how much power will be used in a building a year after its completion and still less what the consumption will be five years later. Yet by careful comparison with other buildings of similar type, close approximations can be, and are, derived.

BUILDING POWER PLANT A COMPLEX PROBLEM.

The building power plant presents for consideration a most complex question and even when convinced of its economy the first question asked is, "How much will it cost?" It has been argued by some that, where a heating plant *must* be installed in a building in any event, the power plant is only a side issue made necessary in order to secure the "by-product" of electric current. It is claimed that high-pressure steam in passing through an engine loses only 5% of its heat unit value and that in exchange for this 5% loss of heat the electric current is produced.

ARGUMENTS AGAINST THE INDEPENDENT PLANT.

Of course the arguments against power plants in buildings center around the initial investment and the upkeep. Combined with these there are usually four major arguments put up to the owner by the public service companies. These consist of the following:

(*a*) That the power plant cannot be built for the cost estimated.

(*b*) That the repairs and maintenance will be higher than supposed.

(*c*) That a cut in cost of electric current is probable in the near future.

(*d*) That some unexpected invention may be made any day which would make the apparatus in the power plant obsolete, resulting in a dead loss to the owner.

The owner, who lacks the technical knowledge to discriminate between reasonable and unreasonable statements along this line, is not capable of giving such claims a correct appraisal. For this reason the engineer must not only be prepared to prove his own case from an engineering standpoint, but must also stand ready to argue its merits from a non-technical and purely practical standpoint.

There can be no doubt that the elimination of a power plant from any building is—in certain respects—very desirable. For instance, coal and ash-handling dirt can be avoided, a stack can be eliminated, space in the basement—more or les valuable for storage—is made utilizable, etc. But if a *heating* plant *must* be installed this feature loses its force for, with a heating plant, the coal and ash nuisance must be endured, a stack will have to be built and considerable space surrendered in the basement for boilers and other heating equipment.

As a general thing the following may be set down as constituting items favorable or detrimental for the installation of a power plant in a given building.

CONDITIONS THAT DETERMINE ADVISABILITY OF ISOLATED PLANT.

Favorable

Long hours of occupancy
Heavy light and power demands
Large building
Separate heating plant necessary
Skilled attendance
High electric service rates
Low cost of coal

Unfavorable

Short hours of occupancy
Small light and power demand
Small building
District heating available
Non-skilled attendance
Low electric service rates
High cost of coal

To make a fair comparison between a plant or no plant, two operating estimates must be made—one assuming power, heat and light produced on the premises and the other assuming one, two, or all to be purchased from service companies at their regular or best-quoted rates. In order to secure legitimate and comparable results the same amount of service should be used while computing on each basis, and it is here that the designer must use his judgment. Conditions are frequently found where the assumption of a large load would show an economy for the plant, when a smaller loading would result in a saving by using street service.

It is manifestly unfair to assume abnormal conditions on either side of the question and averages from other similar buildings should determine the quantities decided upon.

Another feature is the cost of breakdown service made by the public service companies which is a necessary adjunct to a *cheap* building power plant. To make the power plant sufficiently trustworthy so that this breakdown service may be omitted will require duplicate apparatus and an increased investment.

SUITABILITY OF OUTSIDE ELECTRIC CURRENT AN IMPORTANT FEATURE.

The suitability of the outside electric current for the uses in the building also has a most important bearing on the matter. Oftentimes certain apparatus to be installed requires a current of a given description. For example, electro-plating requires a direct current of low voltage and no other current will do. Again laboratories may require alternating curent of a given phase and cycle. Where current is purchased from an outside company it quite likely will not correspond to that best suited to the needs of the building and, therefore, will require some modification before being most satisfactory for use.

This may involve a rotary-converter, or motor generator, transformer, etc., all of which must be charged to the cost of outside current in order to arrive at a true comparison.

Advantages on the other side may also occur with high pressure steam available in the building. Its current consumption can be then cut down by using steam-driven vacuum pumps, high-pressure lift traps, and engine-operated fans.

In succeeding issues the new department of "Power Plant Engineering" will take up, in a simple, straight-forward way, the various apparatus used for small power-plant work, with a discussion of its uses, allowable capacities and other features that now come within the scope of the heating and ventilating engineer.

Notes

A bulletin (No. 119) on "The Analysis of Coals" has been issued by the Bureau of Mines. This bulletin contains complete data on various grades and sizes of coal obtained throughout the U. S. and also covers many foreign coals. One of the most interesting features is the price per ton paid by the various government buildings throughout the country from 1908 to 1915. The entire matter covered in the pamphlet, which contains over 100 pages, is carefully indexed and prepared for ready reference.

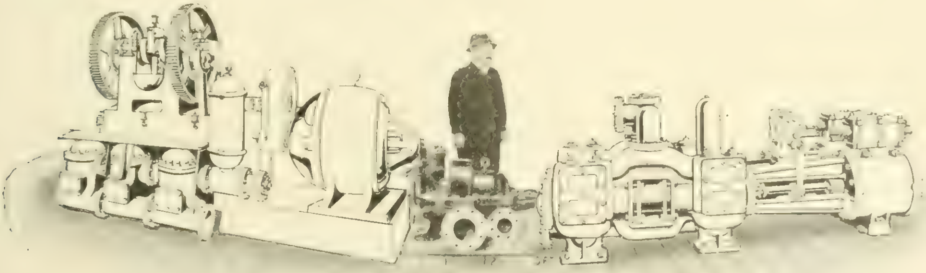
* * *

To meet the increasing demand for centrifugal boiler feed pumps the DeLaval centrifugal boiler feed pump coupled to an independent steam turbine has been designed. The matter of space conditions has also been considered by the manufacturers who have produced a unit taking less space than other pumps of similar capacity of the duplex steam type, or the triplex motor-driven type, the duplex pump weighing about five times as much and occupying eight times the floor space. Comparative views of the three types of pumps showing the relative sizes are shown.

To provide against any possibility of racing the unit is equipped with an emergency governor. This consists of a pin contained within a hole bored diametrically through the shaft. The pin is held by a spring from flying out under the influence of centrifugal force. When the speed reaches a certain point, the spring is compressed so that the pin strikes a trip, releasing another spring by which the governor valve is closed at once and completely. Racing and excessive over pressure are therefore impossible. The normal speeds of these pumps vary from 1,800 to 3,500 r.p.m., according to pressure and capacity, and due to the heavy shafts employed are far below the critical speeds.

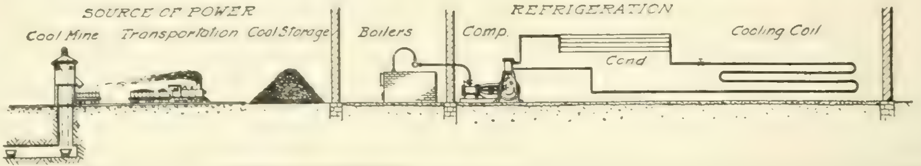
* * *

Minneapolis, Minn.—According to the *Minneapolis Tribune,* the public utility companies of the United States have just experienced the most prosperous year in their history. The great activity in steel, copper and other industrial lines, partly due to the European War and partly to the general prosperity of the country, naturally called for a large increase in the consumption of motive power to carry on this enormous business. The light, heat and power companies reported record-breaking earnings. It is pointed out, however, that the great increase in the earning power of the public service corporations did not go into the reserve account of the companies, as would generally be expected. The cost of materials necessary in the manufacture of power and light increased very rapidly during the past year. This caused serious inroads in the net earnings of the various properties. The total output of electricity of the central power stations of the United States during the year 1916 was 23,300,000,000 kilowatt hours, the largest in the history of the industry, and an increase of 22.5 per cent over the year 1915. The total was double that of 1912, the year of the last census. The gross earnings of such companies amounted to $520,000,000, as compared with $302,115,000 in 1912, or an increase of approximately 72 per cent. Expenses increased from $234,419,000 in 1912 to a total of $424,000,000 last year, or an increase of about 80 per cent. The number of persons employed in this branch alone amounted to 94,000 in 1916, against 79,000 in 1912. It is estimated that at present fully 5 per cent of the population of the United States derive their livelihood from the electrical industry.



DE LAVAL STEAM-TURBINE DRIVEN BOILER FEEDER COMPARED WITH DUPLEX STEAM PUMP AND TRIPLEX MOTOR-DRIVEN PUMP, ALL OF SAME CAPACITY.

AIR COOLING AND REFRIGERATION



Notes on Air Cooling Practice

The science of heating is only imperfectly completed unless it is also combined with the art of air cooling. In fact, it is entirely true that a human being suffers more from the extreme of heat than from the extreme of cold.

This being so, the question suggests itself as to why the science of heating has been accorded so much more importance than the subject of cooling. In reality this is caused simply by the consideration of freezing. If a building has its temperature fall below 32° F., every water pipe in the entire structure is in danger of freezing and bursting, resulting in damage from water. Thus, long before the thermometer gets to the point where the cold becomes a real bodily discomfort, other considerations render the supplying of artificial heat imperative.

How long will it be before the demands of physical comfort will insist that a building not only must not go below 70° F. in winter but also that it must not go *over* 70° in summer? Many of the manufacturers of the country, notably those engaged in work connected with the paper industry, have found temperature and humidity control an absolute essential to good work; This means that the buildings must be cooled in summer as well as being heated in the winter. Some buildings are operating artificial cooling systems purely for comfort, and if cooling could be accomplished through a comon steam radiator as simply as heating is carried out, many additional buildings would utilize this desirable feature.

Artificial cooling, however, cannot be accomplished with the same facility as artificial heating; the apparatus is more complex and the means of cooling confined within certain rather restricted limits. What might be termed "direct cooling" (corresponding to "direct" heating) is not practical in occupied rooms owing to the accumulation of moisture which freezes into ice on the cooling surface, a familiar example of this being the exposed pipes in a refrigeration box which are often entirely obscured from sight by the "frosting" of the outside.

Successful cooling of occupied rooms can hardly be carried out practically by any other means than that of the "indirect" system. In this method the air is moved by a fan and is cooled by the evaporation from a water spray or by being drawn across a cooling surface on which the collection of ice does not matter.

EFFECTIVENESS OF AIR WASHERS.

For cooling economically the common air washer is most satisfactory but the temperature range is rather limited unless cold well water in large quantities is obtainable at low cost. Where well water is not obtainable the water used in the washer may be cooled by artificial refrigeration or brine coils may be used in a manner similar to the steam coils installed for heating.

It must be remembered that artificial cooling should not be carried on at present with too lavish a hand, for the cooled building is going to be the exception rather than the rule for some time to come. It is human to judge by comparison and the entrance into an over-cooled building from the glaring heat of the street may, in extreme temperatures, produce too much of a change for comfort. Some buildings vary the temperature from day to day, maintaining a higher temperature within when the outside temperature climbs up so as to produce less of a contrast of entering from the outer air.

DIRECT EXPANSION AND ABSORPTION METHODS OF COOLING.

Where artificial refrigeration is to be

installed in a building, either entirely for the purpose of summer cooling, or to meet other requirements with the building cooling only as a side issue, there are two methods which may be used—the "direct expansion," which is the simplest—and the "absorption" method which is more complicated but gives a little better control. These methods are simply two means of accomplishing the same end, just as a steam system or a hot water system will each heat a building equally well when properly designed.

One thing that should always be borne in mind in dealing with refrigeration systems and that is "Care." The refrigerating engineer who has *successfully* operated plants is invariably a *careful* engineer and one who looks after the details of the system, the small leaks, the condition of his valves, the temperatures and pressures recorded, etc., with great exactness. Little matters which might be safely neglected for awhile in a power plant should receive instant attention in a refrigeration plant to avoid their becoming a positive menace.

For this reason the runs of piping, location of valves, and general arrangement of the plant to facilitate inspection and quick control are most vital. Access to all parts should be carefully arranged and blind alleys and pits avoided as far as possible. All piping should be freely exposed to view and the apparatus gauges, and recording instruments placed in conspicuous and well-lighted positions.

While there are several mediums which may be used in the production of artificial refrigeration such as air, carbon dioxide, and sulphur dioxide; the most suitable as well as the most commonly used is ammonia gas. Therefore, a consideration of refrigeration is to a large extent a study of ammonia and its properties. Anhydrous ammonia is liquified ammonia which results from the compression of ammonia gas at high pressures and contains no water; it should not be confused with aqua ammonia which is only a solution of ammonia gas and water.

Anhydrous ammonia boils at about 28° below zero Fahr. and a pound of liquid ammonia when expanded into ammonia gas at atmospheric pressure occupies about 21 cu. ft., this expansion and vaporization requiring some 555 B.T.U. in the process. Liquid ammonia is colorless and weighs about 42 lbs. per cubic foot being only about two-thirds as heavy as water. Commercial ammonia is obtainable in a very pure condition, the impurities seldom running over ½ of 1%, and often as low as 1/10 of 1%. If the impurities (which gradually accumulate in a system) reach 2% they become detrimental as they interfere with the action of the gas.

PROPERTIES OF AMMONIA.

The following table illustrates some of the more interesting properties of ammonia at various temperatures:

Temperature Degrees F.	Gauge Pressure Lbs. Per Sq. In.	Latent Heat B.T.U.	Volume of 1 lb. of Gas, Cu. Ft.
—25°	1.47	570.68	16.44
—20	3.75	567.67	14.48
—15	6.29	564.64	12.81
—10	9.07	561.61	11.36
— 5	12.87	558.56	9.89
0	15.67	555.50	9.14
5	19.47	552.43	8.04
10	23.85	549.35	7.20
15	28.24	546.26	6.46
20	33.25	543.15	5.82
30	44.72	536.92	4.73
70	114.49	511.52	2.24
100	200.42	491.5	1.36

Refrigeration is calculated by the B.T.U. method, largely in the same manner as in heating work, except that the process is reversed. All the losses are based on heat transmission taken in B.T.U. and the unit of plant capacity is "tons" of ice, (equivalent to horsepower of a heating system), one ton capacity consisting of absorbing sufficient heat to melt one ton of ice or 2,000 lbs. × 142 B.T.U. = 284,000 B.T.U. In rating an apparatus the "tons" used is the tons per twenty-four hours and not tons per hour.

Notes

The following cities have artificial ice rinks—New York, Chicago, Cleveland, Boston, Montreal, Quebec, Toronto, Hamilton, Vancouver, Portland, Oregon and San

Francisco. Several of these were built last year and other cities will fall in line this year.

* * *

An ice plant is not rated by its hourly capacity but on the basis of 24 hours, so that to obtain the capacity of a refrigerating plant the heat absorption per hour must be multiplied by 24 in order to correctly get the plant rating. With a heating plant the heat supplied per day must be divided by 24 in order to get the plant capacity and horsepower—an important difference between the method of ratings.

* * *

Compressed air is used for refrigeration on ship board and in other places where stray ammonia fumes would be particularly objectionable.

* * *

The distribution of brine over the floor in an artificial ice rink is one of the most difficult problems of refrigeration. Unless the flow is even and equal over the entire surface soft spots will develop resulting in the whole surface being spoiled. One method of overcoming this consists of the employment of two supply headers, one at each end of the rink and the supplying of the pipes on the floor alternately so that the brine in one pipe is flowing in one direction and the brine in the two adjacent pipes in the opposite direction. At the return ends of each line headers are placed and the return brine is picked up in a manner similar to that used in the supply lines; this is illustrated in Fig. 1. In order to make assurance doubly sure each pipe is valved at the supply and return header so that the flow in every line can be controlled absolutely.

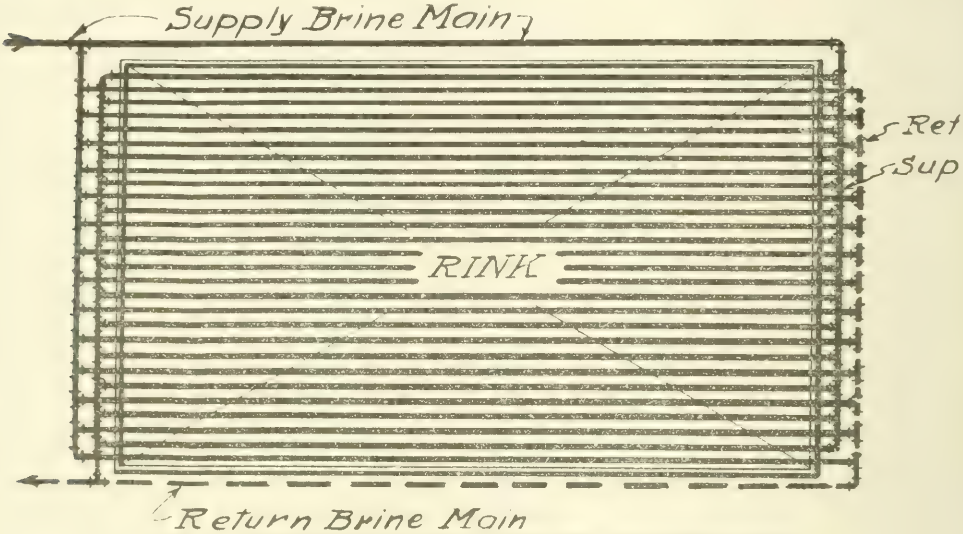


FIG. 1.—ARRANGEMENT OF BRINE PIPING FOR ICE SKATING RINK.

◆

Proposed Boiler Rules of the New York State Industrial Commission.

A volume of proposed rules for the construction, installation, inspection and maintenance of steam boilers has been compiled by the New York State Industrial Commission and public hearings were arranged to be held in various cities throughout the State during April. The proposed code, with index, takes up 129 pages. Part 1, Section 1 is devoted to new installations of power boilers, occupying 80 pages. Part 1, Section 2 is devoted to new installations of "boilers used exclusively for low pressure steam and hot water heating and hot water supply." The maximum allowable working pressure for low pressure steam heating boilers is given as 15 lbs. per square inch. Part 2, Section 2 refers to existing installations. This is followed by an appendix, covering efficiency of joints, braced and stayed surfaces, safety valves and fusible plugs.

◆

Court Decisions on Workmen's Compensation Law.

Court decisions in New York State on the workmen's compensation law, covering the period from July 1, 1914 to August 1, 1916, have been issued as a special bulletin by the New York State Department of Labor. This covers the entire period that the law has been in effect. The volume, which contains 406 pages, has a subject index, and also a complete list of cases.

Standard Methods of Testing Discussed by British Heating Engineers

A New Unit Proposed to Express Boiler and Radiator Capacity, to Be Known As a "Centitherm."

One of the principal items on the programme of the annual meeting of the Institution of Heating and Ventilating Engineers, held in London, England, February 13, was a paper on "Standard Methods of Testing," by A. H. Barker. The principal points in this paper are given in the following summary, made by *The Plumber and Journal of Heating* (London):

The author said he would like again to consider the desirability and the possibility of adopting standard methods of testing heating and ventilating plants.

The object of laying down standard methods of testing is that it might be possible to gauge the success of a design on sound principles and to eliminate automatically all the factors which hid the true results. If such tests were properly carried out it would be impossible for a bad apparatus to masquerade as a well-designed one, and attention would be automatically called to the parts of the design which were wrong. A bad test did none of those things.

Thus, the ordinary method of testing a heating apparatus by measuring the temperatures produced in rooms, especially in variable conditions of the outside weather, is of no value whatever for giving exact information about the apparatus or to serve as a guide in the design of future apparatus. Such a test, however, if it could be so called, might conceivably satisfy a client, and it might also satisfy an engineer that the apparatus was not liely to be any more trouble to him.

It would be absurd to deny that these were two very important things from the present commercial point of view. All faults of design are automatically buried if the apparatus is once made to work to the satisfaction of the client, even if that satisfaction is based on the client's ignorance of the defects. That is the only real ground on which the present system can be defended.

At the same time one should not shut his eyes to the fact that such tests are of no scientific value whatever, and of no technical value to the engineer. They do not even prove that his apparatus is well designed, nor show him how he can do better in the future, nor in what way he might produce an equally satisfactory result with half the expenditure of money; nor that the client could not get an apparatus, which would satisfy him equally well, for an expenditure of fuel of 60 per cent of what he has actually to spend, nor does it give the engineer any information of any kind of future value.

WOULD TEST VARIOUS PARTS OF SYSTEM INDEPENDENTLY.

The author proceeded to consider the testing of details, prior to taking the plant as a whole.

The first portion of the apparatus that claims attention is the boiler, and of all firms is expensive to erect and difficult to test satisfactorily.

A testing plant such as formed part of the equipment of our larger boiler-making firms is expensive to erect and difficult to work. It is designed for the purpose of rapidly and thoroughly testing every feature of one boiler after another.

Describing the bare minimum of apparatus required for making a satisfactory boiler test, such as could in favorable circumstances be erected by an engineer in his own yard, the author said for such a purpose it is of no use testing a boiler on two separate occasions without securing uniformity in (1) quality of fuel; (2) rate of fuel consumption; (3) the flow and return temperatures at which the boiler is working. But if these factors can be kept standard and constant then there is no reason why a perfectly uniform result cannot be secured time after time, and much valuable information arise therefrom.

TEST OF FUEL.

The first of these questions, namely, the burning quality of the fuel, is a great difficulty. Mr. Barker said he did not know of any test which would determine the burning quality of the fuel in such a way that different fuels could be used for testing purposes. To get over this difficulty it would be necessary to fix arbitrarily on a certain type of fuel for testing purposes only.

All real anthracites burn in pretty much the same way, and it might be remarked that there is a great deal of coal sold (in

England) as anthracite, which is in reality not anthracite at all. Hence, if a real anthracite were used for the purpose, a careful test of its calorific value would be sufficient. This test could be best made with a bomb calorimeter, but this instrument is expensive and requires a god deal of skill to use. A much cheaper method and one very satisfactory to use was illustrated by the author as follows:

A glass jar, perhaps 20 in. long × 4½ in. diameter, has fixed inside it an ordinary lamp glass with a stopper at the top through which a glass pipe passes. A small perforated copper thimble is provided to hold about 2 grams of powdered fuel, which is carefully collected from the bulk to make sure that a representative sample has been taken.

A small cylinder of oxygen is employed to force and keep the lamp glass full of the oxygen. The fuel is ignited by a spark, and the oxygen causes the fuel to burn rapidly and force the heated product of combustion out into the water.

The weight and temperatures of the water are observed, and several carefully selected and weighed samples of the fuel burnt in this manner, and the calorific value of the fuel thus determined by the rise of temperature in the water. Such a test as this is a necessary preliminary to any satisfactory boiler test.

TEST OF BOILER.

Although, as had been said, such tests can only be easily made on a plant already fixed up for testing purposes, it might be well to explain how they could conceivably be made in an engineer's own yard, with the necessary precautions to ensure uniformity.

Constancy of temperature may be secured by fixing a large tank containing perhaps 2,000 gal. of water, kept constantly at 130° F., a few inches above the level of the top of the boiler, and connecting a pipe from the tank so as to cause the water to flow into the boiler return, and provided with a valve that the flow could be regulated to such a value that the outflow temperature was constantly 160°.

The water, after passing through the boiler, may be cooled again to 130° by exposure to the air by running over a large surface of corrugated iron and allowed to fall into a tank, from which it is again pumped up to the upper tank, its temperature being first reduced to 130° by the addition of cold water or otherwise.

If a large chimney were not available it would be necessary to apply artificial draft to the boiler by means of an induced draft fan, drawing from the boiler outlet and discharging into the open air. The fan could readily be arranged to maintain the required difference of pressure between the firegrate and the outlet, for it is on this that the rate of combustion of the fuel depends.

The method whereby the rate of combustion can be measured is a very great difficulty. The only really satisfactory method is to fix the entire boiler on the platform of a weighing-machine, and take its weight, fuel and all, at the end of every ten minute interval. This involves, of course, making mercury seal connections to the boilers, so that its apparent weight is not influenced by stresses in the connection pipes, and this is necessarily a very expensive proposition. As it is impracticable in a scratch test, the only way is to arrange for a long test of not less than ten hours' duration after the fire is burning a full power, weigh in the standard fuel, and burn it at such a rate as to maintain the temperature desired, the water supply being kept accurately constant at an appropriate value.

The author suggested also that the power of a boiler should be given in units, which might be called "centitherms," or 100 therms, or British thermal units, per hour, and that the same unit be adopted throughout the trade for all purposes.

RADIATOR TESTS.

To calculate correctlv the emission from a radiator from correct sets of tables determined from acurate experiments, with different co-efficients for each individual height and design and for different temperatures, would throw an enormous amount of work on the person making the calculations. In fact, hardly one person in a hundred ever attempts such calculations.

What is really required for practical purposes is not the heating surface of the radiator and not the variable co-efficients of emission, but the *total emission* of each size of radiator under certain standard conditions as to location and temperature. Then there would be no need for any calculations at all. Nobody cares what the surface of the radiator may be so long as it gives off the desired amount of heat. Provided always the radiator temperatures are kept up to the standard, the amount of heat calculated on can be arrived at.

The actual conditions which will secure a constant emission from any radiator are: (1) Still air at a given surrounding air temperature; (2) a given flow and return water temperature, secured by employing a constant flow of water at a given temperature through the radiator; (3) a flat surface of given emissivity, maintained at a constant given temperature at a given distance from the radiator under test. Unless all these conditions could be simultaneously fulfilled it is impossible to obtain uniformity of result from any test.

PROPOSED STANDARD METHOD OF TESTING RADIATORS.

In order to attain this ideal there should be a standard method of testing radiators, which should be somewhat as follows:

Assuming the standard flow and return temperatures to be respectively 160° and 130° F., the radiator should be fixed up on the testing stand 2 in. in front of a large, flat, blackened surface, maintained at a constant temperature of 90°. Water should be allowed to flow through the radiator with top and bottom connections from a large tank maintained at 160°. The flow of water should be increased by a valve, automatically operated or otherwise, until the return temperature was settled at 130°, and the quantity of water required to produce this result flowing from the radiator per hour (w) carefully weighed, and the heat emission in these conditions calculated by the formula $w \times 30$. This figure divided by 100 should be the nominal power of the radiator. Such a surface as would give off 100 therms per hour would be a nominal radiator unit, and the author suggested should be called a "centitherm." This expression would then be used instead of the present "square foot" for all purposes connected with emissions from heating apparatus. Catalogues would then give the number of "centitherms" which a radiator would give off if maintained at standard temperatures.

FRICTION IN PIPES

Great discrepancy exists between the resistance per unit length of different samples of pipes nominally of the same size.

It is at least as important to the heating engineer to know what is the resistance of his pipes as it is to the electrical engineer to know the resistance in ohms per mile of the cable he uses.

The accurate testing of pipes is as complicated and difficult a matter as the testing of boilers and radiators, but it should be possible to erect quite a simple standard testing plant which any heating engineer could use in his own yard, and which would show him the degree of uniformity of the pipe he was buying.

The simplest standard method of testing the uniformity of pipes that the author could devise is as follows:

Two large testing tanks are provided, say 15 ft. apart, and fixed at different levels, one being 12 in. below the other. Means are provided for keeping the level of water in these tanks accurately constant throughout the test.

The method proposed for doing this was the same as adopted in the laboratory for pipe and radiator tests; namely, to provide a large standing overflow-pipe in each tank and allow the water to pass into it at such a rate that the tank just overflowed and no more. Any individual length of pipe could be tested by allowing water to flow from the upper of these two tanks into the lower through the pipe under test, and measuring carefully, by weighing or otherwise, the amount of water which would flow in five minutes under this constant head.

COMPLETE APPARATUS.

Turning briefly to the testing of a complete apparatus, the author said if a heating apparatus was perfectly designed it would fulfill some such conditions as the following with all valves wide open:

1. Supposing the temperature in the flow-pipe near the boiler to be maintained constantly at 160°, then the temperature at the entrance to each radiator should not be less than 155°, and should be almost the same for every radiator in the installation. This was very easy to attain except in very long installations.

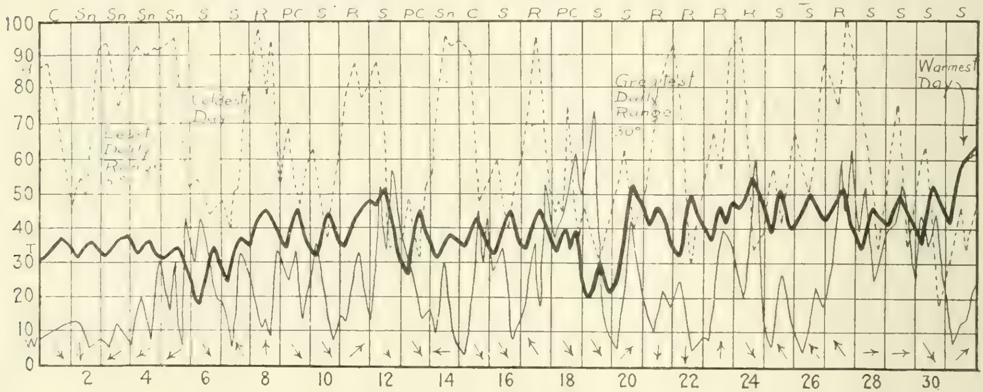
2. The temperature of the return-pipe from each radiator should also be the same within 5°; that is, it should in no case be below 125°, and in no case above 130°. That was as near as could be got in the present state of tube manufacture. It could only be attained by careful and correct design.

3. The total amount of fuel burnt after the apparatus had attained the above-named temperatures during the next ten hours should not exceed $\frac{H}{8}$ lbs. for every ten hours it continued working, when H is the total heat given to the rooms per hour in "centitherms." This condition depended on the efficiency of the boiler and of the coating employed.

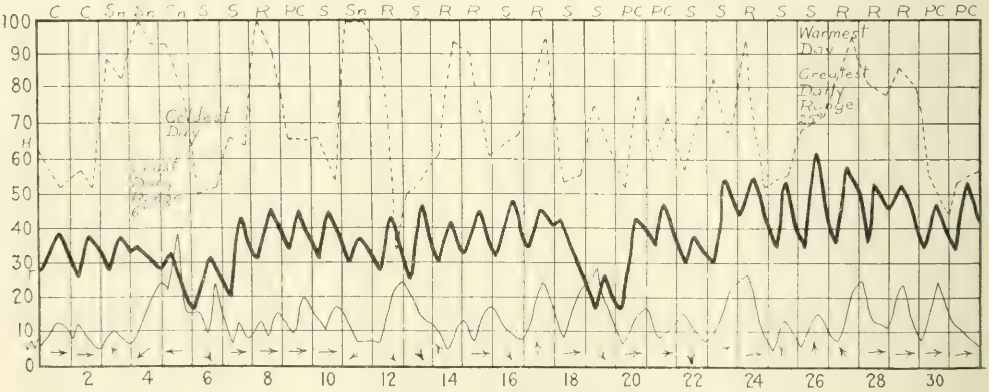
The fire-pot should be filled once at the beginning of the test, once after a period of 3 hours 20 minutes, and once after the expiration of 6 hours 40 minutes, the fires being properly cleaned on each occasion.

The Weather for March, 1917

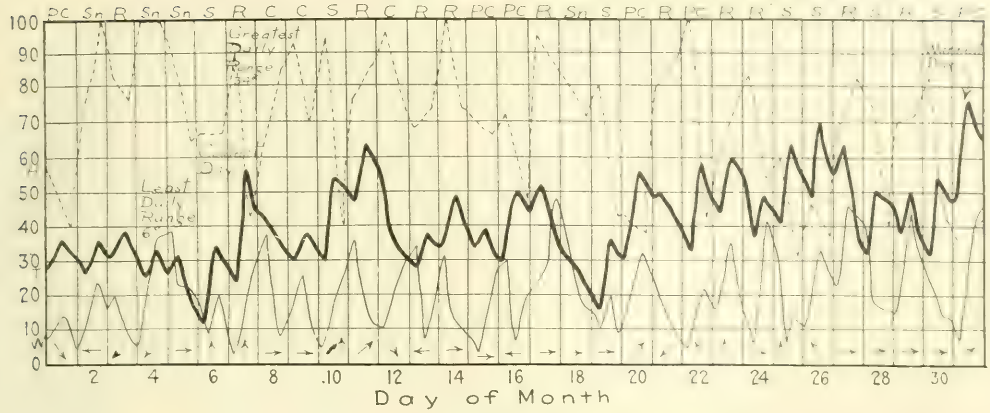
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	64	61	73	76	80
Date of highest temperature	31	26	31	31	31
Lowest temperature, degrees F.	18	17	12	11	14
Date of lowest temperature	6	5	6	5	4
Greatest daily range, degrees F.	30	25	34	31	31
Date of greatest daily range	20	26	7	31	26
Least daily range, degrees F.	5	6	6	5	6
Date of least daily range	3	4	4	12	2
Normal temp. for month, deg. F.	39	37	41	38.8	46.6
Normal mean temp. for month, deg. F.	38	35	39.5	34.4	43.5
Total rainfall, in.	3.38	3.73	3.36	2.1	1.8
Total snowfall, in.	11.4	12.9	13.1	2.11	0.3
Normal precipitation, this month, in.	4.10	4.08	3.01	2.55	3.43
Total wind movement, miles	15,444	9,265	11,389	11,921	14,241
Prevailing direction of wind	N. W.	W.	W.	W.	S.
Average hourly wind velocity, miles	20.8	12.5	15.3	16	19.1
Number of clear days	9	12	8	7	10
Number of partly cloudy days	7	10	10	12	11
Number of cloudy days	15	9	13	12	10
Number of days on which rain fell	8	9	11	4	12
Number of days on which snow fell	5	4	3	5	..
Snow on ground at end of month, in.	..	..	..	..	..



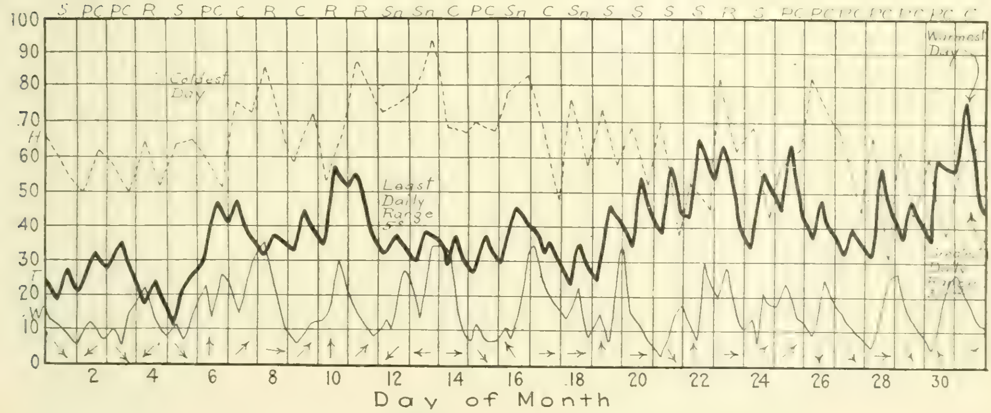
RECORD OF THE WEATHER IN NEW YORK FOR MARCH, 1917
(Hourly Observations of the Relative Humidity Are Recorded on This Chart.)



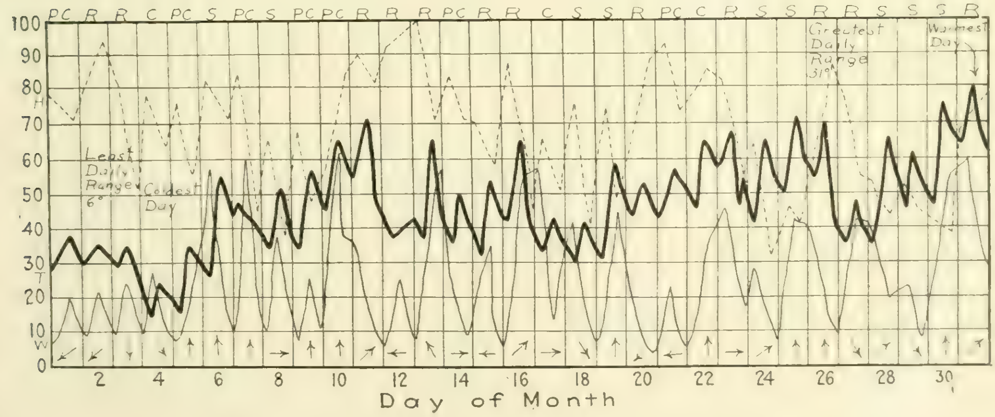
RECORD OF THE WEATHER IN BOSTON FOR MARCH, 1917



RECORD OF THE WEATHER IN PITTSBURGH FOR MARCH, 1917



RECORD OF THE WEATHER IN CHICAGO FOR MARCH, 1917



RECORD OF THE WEATHER IN ST. LOUIS FOR MARCH, 1917

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

NATIONAL DISTRICT HEATING ASSOCIATION

Programme for Ninth Annual Convention.

Following is the revised programme for the ninth annual convention of the National District Heating Association, which will be held at the Pontchartrain Hotel, Detroit, Mich., June 12-15.

First Session, Tuesday Morning, June 12.

Address of welcome.
Response, George W. Martin, New York.
Report of executive committee.
Election of new members.
President's address.
Report of secretary-treasurer.
Appointment of nominating committee.
Report of constitutional revision committee.

Second Session, Tuesday Afternoon, June 12.

Address by Professor John R. Allen, University of Michigan.
Report of station operating committee by J. G. DeRemer, chairman, New York.

Third Session, Wednesday Morning, June 13.

Paper by Nelson S. Thompson, Washington, D. C.
Address: "A Study of District Heating in the Central West," by Professor J. D. Hoffman, University of Nebraska.
Report of underground construction committee, by H. A. Austin, chairman, New York.

Fourth Session, Wednesday Afternoon, June 13.

Report of public policy committee, by S. Morgan Bushnell, chairman, Chicago.
Report of educational committee, by George W. Martin, Chairman, New York.

Fifth Session, Thursday Morning, June 14.

Discussion of report of research committee.
Report of accounting committee, by C. A. Gillham, chairman, New York.

Sixth Session, Thursday Afternoon, June 14.

Address on "Rates," by Halfred Erickson, Chicago.
General discussion on rates.
Report of nominating committee.

Seventh Session, Friday Morning, June 15.

Report of meter committee, by Fred B. Orr, chairman, Chicago.
Report of record committee.
Election of officers.
Discussion session. Subjects as follows:
- Value of associations and their work, opened by D. L. Gaskill.
- Underground crossings, opened by H. R. Wetherell.
- Heat losses from mains under various conditions, opened by R. C. March.
- Ash and coal-handling problems, opened by J. L. Hecht and J. C. Martin.
- Temperature regulation, opened by H. R. Wetherell.
- Customers' piping in relation to district heating, opened by J. C. Hauser.

Entertainment.

The annual banquet of the association will be held at the Hotel Ponchartrain Wednesday evening, June 13. Outings for the ladies will include an automobile ride on Thursday afternoon, June 14, terminating at the Detroit Boat Club, on Belle Isle. The same evening there will be a theatre party for all.

On Friday afternoon, June 15, the entire party will go on a boat ride up the Detroit River to St. Clair Flats.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Chicago Chosen for 1917 Convention.

The twenty-ninth annual convention of the National Association of Master Steam and Hot Water Fitters will be held in Chicago, Ill. The dates chosen are June 11-15, Monday to Friday, inclusive. Headquarters will be at the Hotel Sherman.

Master Steam Fitters' Association in New Quarters.

New headquarters for the National Association of Master Steam and Hot Water Fitters have been taken at 50 Union Square, New York, Seventeenth Street and Fourth Avenue. The new quarters are on the ninth floor of the Germania Life Building. The offices of the association have been located, for the past twenty years, in the Wool Exchange Building, 260 West Broadway, New York.

Wisconsin State Association.

Officers were elected as follows at the seventh annual convention of the Master Steam and Hot Water Fitters' Association of Wisconsin: President, Frank H. Meadows, Milwaukee; vice-president, James B. Sullivan, Stevens Point; secretary and treasurer, Fred Kaufman, Milwaukee; recording secretary, Albert W. Luebke, Milwaukee; sergeant-at-arms, M. Mueller; Milwaukee. Board of directors: Edmund Grassler, Milwaukee; E. J. Sullivan, Kenosha; Albert W. Luebke, Milwaukee; and Frank Downey, Milwaukee.

New York City Association.

New officers were elected at the annual meeting of the New York Master Steam and Hot Water Fitters' Association, held March 27: President, William H. Curtin; vice-president, J. E. Rutzler; treasurer, J. T. Dyas; secretary, Henry B. Gombers. Board of directors: William H. Curtin, J. E. Rutzler, J. T. Dyas, Charles G. Witherspoon and Charles Schneider. The board elected William H. Curtin chairman, and J. E. Rutzler, vice-chairman.

Newark (N. J.) Association.

Newly-elected officers of the Master Steam and Hot Water Fitters' Association of Newark, N. J., are as follows: President, John H. Nelles; vice-president, John G. Keller; treasurer, T. B. Cryer; secretary, Harry Geiser. George W. Dennis was elected a member of the executive committee.

Washington (D. C.) Association.

Officers elected at the annual meeting of the Master Steam and Hot Water Fitters' Association of the District of Columbia, are as follows: President, I. A. Slyder; vice-president, D. D. Condon; secretary and treasurer, Thomas Egan.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

New York Chapter Elects Officers.

New officers were elected as follows at the April meeting of the New York Chapter, held at the Building Trades Club, April 16: President, Frank K. Chew; vice-president, C. E. Pearce; secretary, C. W. Obert; treasurer, William J. Olvany. Board of governors: Arthur Ritter, P. H. Seward and H. G. Isertell. The installation ceremonies will take place at the May meeting.

The retiring president, Arthur Ritter, announced that the board of governors had passed a resolution pledging the loyalty and services of the chapter to the government in connection with the war, the announcement being greeted with applause.

After the routine business was transacted, the meeting was turned over to M. W. Franklin, the chairman of the evening, who carried out the sentiments of the occasion by wielding as a gavel a 4-in. shrapnel shell. Mr. Franklin introduced Naval Constructor George H. Rock, U. S. N., of the New York Navy Yard, who took for his subject "The Ventilation of Battleships." Naval Constructor Rock gave a comprehensive review of the problems that have to be met in the ventilation of battleships, one of the most important being the prevention of pipe corrosion. He also told how the use of steam radiators aboard ship had given place to the indirect systems which are now in universal use.

One of the most interesting statements made was that the ventilation of ships on any large scale is a development of the past few years and that this applies to the vessels of foreign countries as well.

The main portions of Captain Rock's address were withheld from publication.

President Ritter stated that the May meeting on May 21, would be in charge of a committee headed by George W. Martin, of the engineering firm of Martin and De Remer, New York. Efforts are being made to secure as the principal speaker an army engineer-officer to talk on "Military Preparedness."

Illinois Chapter Discusses Smokeless Boilers.

"Noven Types of Heating Boilers" was the topic for the April meeting of the Illinois Chapter which was held at the Engineers' Club, Chicago, April 9. The American Radiator Company's smokeless boiler was described by H. L. Whitelaw; Charles F. Newport of the Newport Boiler Company gave an illustrated address on magazine boilers; and Ernest Mehring, president of the Ernest Mehring Co., Chicago, representing the Kanawha Mfg. Co., of Charleston, W. Va., also gave a talk, illustrated with slides, on smokeless boiler construction and operation. These speakers were followed by Osborn Monnett, formerly chief of the Chicago Smoke Inspection Department, who stated that efficient operation of boilers, whether for high or low pressure plants, was essential in lowering smoke densities.

In the absence of President Powers, Dr. E. Vernon Hill, vice-president, officiated.

A committe was appointed to take charge of the entertainment at the forthcoming semi-annual meeting of the society which will be held in Chicago, July 18-20. This committe will consist of James Cutler, Benjamin Nelson, E. J. Claffey and August Kehm.

Secretary Stacey anounced the election of the following to membership in the chapter: Oliver L. Bear, A. A. Blomfeldt, H. W. Nelson, F. Van Inwagen and H. L. Whitelaw.

John F. Hale, who had represented the chapter at the recent convention of the National Committee on Engineering Co-Operation, held in Chicago, March 29, said that he expected to be able to make a report covering various points which have developed in connection with engineering co-operation. This report will be presented at the summer meeting of the heating engineers' society.

Annual Meeting of Eastern Pennsylvania Chapter.

The annual meeting and dinner of the Eastern Pennsylvania Chapter was held at Kugler's Restaurant, Philadelphia, March 8, and was largely attended. Officers elected were: President, George W. Barr; vice-president, J. T. J. Mellon; treasurer, H. P. Gant; secretary, George Boon.

D. Knickerbacker Boyd was the principal speaker, his address being devoted to a discussion of co-operation between the heating engineer and the architect.

A joint meeting of the local chapters of the American Society of Mechanical Engineers and of the American Society of Heating and Ventilating Engineers was held at the Engineers' Club, Philadelphia, March 27, both chapters being well represented. The feature of the meeting was the presentation of a paper on "Central Station Heating," by Walter J. Kline, of the American District Steam Company, in which he gave a concise review of up-to-date methods in this field.

The regular monthly meeting of the Eastern Pennsylvania Chapter, held April 12, was devoted to warm air furnace heating. A paper on the subject by Irwin F. Grumbein was well received. Mr. Grumbein renewed the claim that heating and ventilating by this method has many advantages for certain types of buildings. He also emphasized the necessity for proper installation of such systems.

The May meeting was scheduled for May 8 the subject for discussion being "Heat Regulation."

Kansas City Chapter Inspects Radiator Manufacturing Plant.

Thirty members and guests of the Kansas City Chapter met at the Tea Cup Rooms, Kansas City, for supper, after an inspection trip had been made to the plant of the Kansas City Radiator Company, where 6,000 sq. ft. of pressed metal radiation is being turned out per day. The manufacturing methods used and the design of the radiators were explained in detail to the visitors.

The members met later in the City Club rooms upstairs where the topic of the evening, "Boilers and Smoke Prevention," was discussed. Mr. Pease, of the Kewanee Boiler Company, exhibited a series of moving pictures which proved both amusing and instructive as illustrating the experiences with a "smoke producing" boiler and one of the "smoke prevention" type.

Mr. Howe, of the American Radiator Company, then gave a talk on methods to be used to prevent the formation of smoke in boilers not of the smokeless type. These were the alternate firing on first one side and then on the other, the covering only of bright spots in the fire, the coking method of firing whereby the coal is heated gradually, and the double arching of boilers, making a greater travel of the gasses.

Mr. Booth, of the United States Radiator Corporation, gave a review of boiler construction since the days of Watt and brought out the fact that in Europe the development of hot water heating preceded that of steam.

A general discussion showed that the so-called "smoke consuming boiler" is a misnomer, as it should really be called a "smoke prevention boiler," as the idea is to prevent smoke, for smoke once formed in a boiler is almost impossible to consume.

As a member of a committee reporting to the city council on a proposed boiler code, which in all probability will be adopted, Mr. Howe stated that the code recommended was that proposed by the American Society of Mechanical Engineers, which has already been adopted in 25 States, and is tending to make uniform the legal requirements and inspections of boilers, besides producing more like a standardization of output by the manfacturers. Secretary F. A. De Boos was instructed to write Mayor Edwards endorsing his efforts to secure the appointment of a smoke inspector in Kansas City. It was brought out that as it is an admitted fact that house heaters produce as much as 75% to 90% of the smoke in our cities, there can be no question that proper smoke inspection will materially lessen the smoke nuisance. This has become an item of considerable importance in Kansas City during the last two years on account of the apparent failure of the natural gas supply, which was largely used in house heating.

Five new applications for membership in the chapter were received and the applicants elected, making the chapter's present membership, 35.

CORRESPONDENCE

Figuring Exhaust Steam Supply From Engines.

Editor Heating and Ventilating Magazine:

How much direct radiation can be supplied and what is the thermal efficiency of the exhaust from a 100 H.P. simple automatic cut-off governor engine, operating at 100 lbs. gauge pressure, back pressure at atmosphere, requiring 40 lbs. of steam per indicated horse power?

In Carpenters' work on "Heating and Ventilating" there is given a table covering this condition which shows that practically 10,000 sq. ft. of radiation can be supplied. An empirical rule, but one which coincides very closely with experience is that 100 sq. ft. of direct radiation requires the consumption of 3 tons of hard coal per heating season, consequently 300 tons would represent the amount necessary for the 10,000 sq. ft.

Another authority attacks the problem from a different angle, stating that this type of engine, using 40 lbs. of steam per i.h.p., operating 10 hours a day and estimating a heating season of 200 days, will exhaust 80,000,000 lbs. containing 1,121 B.T.U. per pound or a total of 8,968 millions B.T.U., during the period named. If this quantity of steam were separately generated with coal having a caloric value of 12,500 B.T.U. per pound, and a boiler efficiency of 60%, each pound of coal would produce 7,500 B.T.U. of steam, thereby requiring 1.2 millions pounds of coal or 600 tons. Wherein does the descrepancy lie between these two results?

Schenectady, N. Y. D.

The question presented by our correspondent is not entirely clear, not so much as to the method of figuring, but as to just what conditions are to be considered. It is assumed that the question was intended to ask "how many square feet of equivalent direct radiation can be supplied by the exhaust steam from a 100 H.P. engine using 40 lbs. of steam per indicated horsepower *during the time of its operatoin at full load.*" It is obvious that when the engine is operating at full load it consumes 40 lbs. of steam per I.H.P. and for 100 I.H.P. will consume 40 x 100, or 4,000 lbs. per hour. If operated at only one-half the load, approximately one-half the amount of steam is used and since the weight of exhaust steam cannot exceed the weight of the consumed steam it follows that at full load about 4,000 lbs. of exhaust steam would be available, while at lesser loads smaller amounts, nearly proportional to the load, would be available. Of course when the engine was not in operation no exhaust would be available and a make-up through a pressure reducing valve would have to be used.

Steam exhausted at exactly atmospheric pressure will not circulate through a system of steam piping unless assisted by a vacuum pump or other aid. However, assuming such a condition *could* be obtained and steam at exactly atmospheric pressure drawn into a heating system, then the amount of surface is most easily computed by dividing the total amount of steam available by the amount condensed per square foot of direct *cast-iron* radiation.

It is well known that the condensation per square foot of ordinary radiator surface is about ¼ lb. and that with allowance for loss in piping this will increase to about ⅓ lb. per square foot. So with 4,000 lbs. of steam available at full load and ⅓ lb. condensed per square foot about 4,000 × 3, or 12,000 sq. ft. could be supplied. With surface in the shape of *pipe coils* less could be handled owing to their greater condensing power which is about 300/250 or 1.2 times that of *cast-iron* surface. So 12,000/1.2 = 10,000 sq. ft. of surface for pipe coils. On account of small losses in the engine and the possibility of slightly higher condensing ability in some parts of the system we could not recommend over 95% of the above, say 11,400 sq. ft. for *cast-iron* surface, or 9,500 sq. ft. for *pipe coil* surface.

We do not agree with our correspondent that "100 feet of direct radiation requires the consumption of 3 tons of hard coal per heating system," for it has been found that 100 lbs. per square foot of surface is a very close figure for heating work in New York and vicinity where the winter season is considerably more mild than in Schenectady. This would increase our correspondent's empirical rule to 5 tons per 100 sq. ft. or 500 tons for 10,000 sq. ft. of equivalent direct radiation.

The authority who estimated on the engine operating "10 hours per day" left the heating system cold for the other 6 hours during extreme weather (assuming the heat as being on from 6 a. m. to 10 p. m. for zero temperatures outside) and on the other hand made no allowance in his average figures for the year for the average yearly temperature during the winter period of 200 days, this being about 35° F. or just 50% of the maximum. Following the same method of reasoning as used by the authority quoted by our correspondent but with quantities that we consider as found more correct in average practice the following is obtained:

Hours per day (maximum) when heat is required	16
Hours per day (maximum) for engine operation	16
Heating days per season	200
Average heat for season in terms of the maximum	50%
Total heating hours per season 200 × 16 × 50% equals	1600
Total pounds of exhaust steam at 100 H.P. for 200 days of 16 hours each, 40 × 100 × 200 × 16	12,800,000
Utilized in heating system 50% of maximum	6,400,000
B.T.U. avaliable from each pound of coal, 12,500 × 60%	7,500
B.T.U. in 6,400,000 lbs. of steam at atmosphere 6,400,000 × 1,121.	7,174,400,000
Equivalent pounds of coal utilized for heating during season 7,174,400,000/7,500	956,000
965,000 lbs. of coal reduced to tons 956,000/2,000	478 tons

This comes very close to the 500 tons obtained by the other rule.

As far as "thermal efficeincy" is concerned, it is presumed our correspondent refers to the amount of heat contained in the exhaust steam as compared to what could be extracted from it if it had not passed through the engine. In this connection it is necessary to take the B.T.U. of 1 lb. of steam at 100 lbs. gage pressure (1189) and the B.T.U. of 1 lb. of exhaust steam at atmosphere (1151), the other B.T.U. being utilized in the engine, and this gives a thermal efficiency of 1151/11.89, or 96.8%.

Heat Transmitted by Indirect Stacks.

Editor Heating and Ventilating Magazine:

In The Heating and Ventlating Magazine for January, 1917, in the article on "Utilizing Waste Heat for Drying Purposes," it is stated (on Page 21) that "the radiating surface is 176 sq. ft. (per stack) and the two stacks gave off 1,053,000 B.T.U. per hour." This would make the heat transmitted per square foot per hour 1,053,000 — (176 × 2) = 3000 B.T.U. This seems very high. Is there not an error here?

Montlucon, France. A. L.

As this installation was designed by the engineering department of the Clarage Fan Co., Kalamazo, Mich., the foregoing inquiry was referred to the author of the article, who writes as follows:

"We have accurate data that the fan is delivering 6,750 cu. ft. of air per minute and at 20 deg. F. 1 cu. ft. of air at 14 7/10 lbs. atmospheric pressure weighs 0.08258 lbs. The temperature rise has been checked and this is from 20 deg. to 152 deg., which gives a rise in temperature of 132 deg. In addition, the specific heat of air at constant pressure is 0.2375.

"With these data, by multiplying the 6,750 cu. ft. per minute by 0.08258, we obtain 559 lbs. of air handled per minute. Multiplying this quantity by 60, we obtain 1,057,000 B.T.U. per hour. This checks fairly closely with our previous computation. All computations submitted have been made with the slide rule.

"If it is desired to check the amount of heating surface in the stacks, we believe the data given in the article is sufficient and we see no reason why 3,000 B.T.U. per hour per square foot should not be transmitted under the conditions."

Professor C. R. Richards, professor of mechanical engineering and head of the department since 1911, has been appointed dean of the College of Engineering and Director of the Engineering Experiment Station of the University of Illinois to succeed Dr. W. F. M. Goss who has resigned to become president of the Railway Car Manufacturer's Association of New York.

An increase of 50% in first-class postage rates, but not less than one cent additional on each piece of first-class matter, is proposed by the finance committee of the United States Chamber of Commerce as a means of helping to meet the taxes on war loans. It is estimated that this tax would produce $100,000,000 a year.

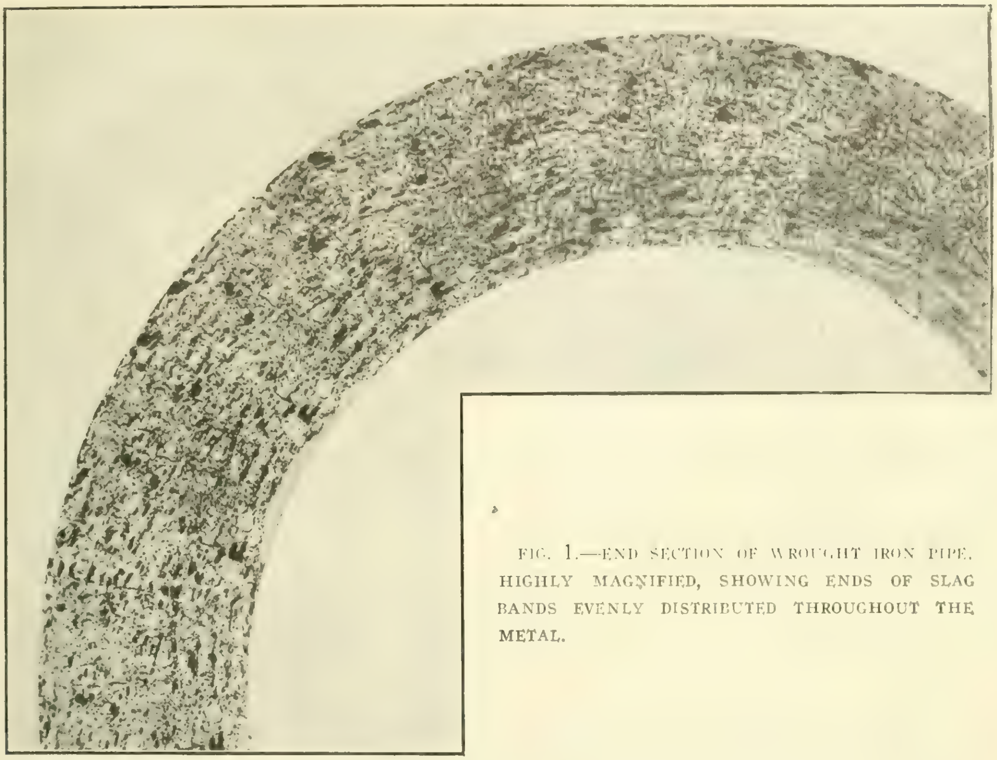


FIG. 1.—END SECTION OF WROUGHT IRON PIPE, HIGHLY MAGNIFIED, SHOWING ENDS OF SLAG BANDS EVENLY DISTRIBUTED THROUGHOUT THE METAL.

The Relation of Slag to the Rust Resistance of Wrought-Iron.

That the reason for the rust resistance of genuine old-fashioned wrought-iron appears to many to be shrouded in uncertainty is probably due to the expectation of finding it deeply buried in a maze of metallurical mysteries. Such, however, is not the case as the following facts will show.

Genuine wrought-iron, as shown in the photomicrograph of an end section of pipe, Fig. 1, contributed by A. M. Byers Company, Pittsburgh, Pa., is composed mainly of iron and slag, the slag appearing black or dark gray and the iron light gray. It is to this slag, which is non-corrosive and electrically almost inert, that genuine wrought-iron owes its resistance to corrosion, as rust can only destroy the iron, not the slag. Allowing for the magnification a little calculation will establish that there are over a quarter of a million slag bands to the square inch, making it easy to understand why they offer such an effective barrier to the entrance of moisture and oxygen, the two most potent factors promoting corrosion.

The protection afforded by the slag contents of genuine wrought-iron, about 6% by volume, has its counterpart in the graphite flakes (Fig. 3) found in pig-iron; pig-iron rusts very little.

The rusted area indicated by the cross lines in Fig. 1 represents the starting of a pit. A glance will show how the individual slag streaks at this point form an almost unbroken barrier with no opening actually larger than .001 in. This illustrates why genuine wrought-iron tends to rust evenly all over, for the corrosion, proceeding along

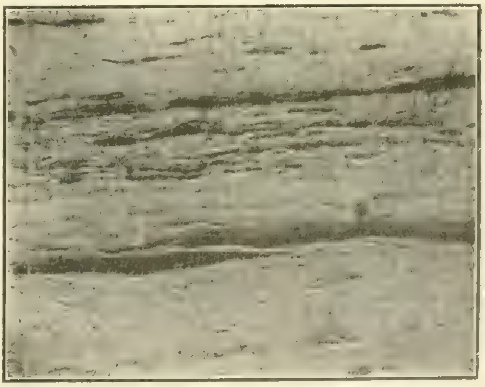


FIG. 2.—LONGITUDINAL SECTION OF WROUGHT IRON PIPE, HIGHLY MAGNIFIED. DARK PORTIONS ARE SLAG BANDS.

the lines of least resistance, tends to spread out instead of going deeper. Without the slag, nothing could retard or stop the pit, which would soon go straight through the pipe and cause an untimely leak.

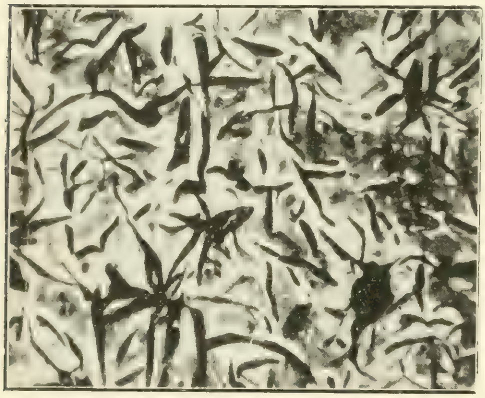


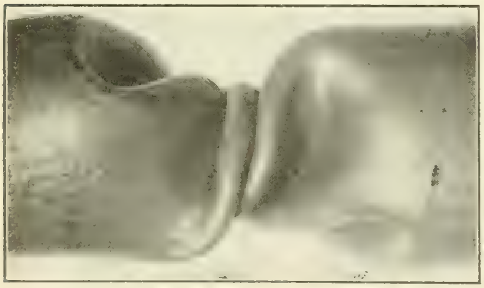
FIG. 3.—SECTION OF PIG-IRON, HIGHLY MAGNIFIED, SHOWING CHRYSTALLINE STRUCTURE PROTECTED FROM CORROSION BY GRAPHITE FLAKES.

The scientifically inclined reader, however, is liable to interpose the objection that there are large open spaces between the individual slag streaks. True, there are open spaces; but most of them are considerably smaller than 1/1000 in., smaller than the smallest pinhole.

◆

Torsional Strength of "National" Pipe.

At first glance, the accompanying photograph looks like a piece of rubber. Instead, it is a piece of 8-in. "National" line-pipe after being subjected to a torsional stress of 713,000-in.-lbs. 8-in. line-pipe weighs in the neighborhood of 29 lbs. per foot and the walls have a thickness of approximately ⅓ in. This will give some indication of the quality of the material used in this pipe to enable it to withstand the enormous strain to which it was subjected. It is brought to the attention of the trade by the manufacturer, the National Tube Co., Pittsburgh, Pa., as a curiosity and an eye-opener to many pipe users who have probably not believed that 8 in. "National" pipe could be subjected to such extraordinary punishment without failing.



8-IN. "NATIONAL" LINE-PIPE AFTER BEING SUBJECTED TO TORSIONAL STRESS OF 713,000-IN.-LBS.

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Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

AIR

The Physical Properties of Air in Relation to Practical Problems. H. Eisert. 3000 w. E Cb Balt, Jl—Feb., 1917. Serial, 1st part. Properties of air in their relation to its most important uses. 40c.

AIR DRYING

Air Drying. Carl Hering. 4500 w. Met. & Chem. Eng.—Feb. 15, 1917. Methods of drying. 40c.

HEATING

Heating Chicago's Tuberculosis Sanitarium. Thomas Wilson. Ills. 1500 w. Power—Feb. 27, 1917. Interesting installation serving 56,000 sq. ft. of direct radiation. 20c.

POWER PLANTS

Power Plant of Wm. L. Dickinson High School. John C. Calahan. Ills. 1500 w. Nat. Engr.—Feb., 1917. Modern methods of heating, lighting, ventilating, power and sanitary equipment. 20c.

School Plant for Power, Heatng, and Ventilation. Ills. 2000 w. Prac. Engr.—Feb. 15, 1917. Combination heating system. Air pressure water supply and other features. 20c.

STEAM PLANTS

Power Equipment for Steam Plants. Robert L. Streeter. Ills. 4500 w. Ind. Man.—March, 1917. Seventh part of a serial. Some auxiliaries necessary for economical operation. 40c.

New High-Pressure Central Steam Plant. Claude Hartford. Ills. 1800 w. Power—Feb. 6, 1917. Station at Burling Slip, New

York, for supplying steam to many large buildings. 20c.

Waste Heat

The Utilization of Waste Heat for Steam-Generating Purposes. 2200 w. A S M E, Jl—Feb., 1917. Discussion of Arthur D. Pratts' paper, with closure. 40c.

◆

New Books.

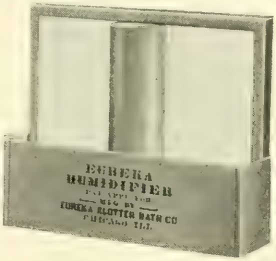
Steam Piping, its economical design and correct layout, by A. Langstaff Johnston, Jr., is the title of a new book forming one of the volumes of the Industrial Management Library. The subject matter comprises a series of articles that appeared in *Industrial Management* during 1915, as consolidated and revised. The author analyzes the factors governing the flow of steam in pipes, and presents a group of curves for use in solving the problems of practical installation and determining the most economical size of pipe to select for any given set of conditions. The pressure-drop curve is based on the formula in Babcock & Wilcox's handbook, "Steam." Two of the chapters take up, respectively, the special problems of low pressure systems and the economies to be obtained through the use of exhaust steam; also the use of the plain reciprocating engine, with exhaust heat as a by-product, in place of more costly equipment. The curves, which are easily the most important feature of the book, are in some cases printed separately, a special container being added to the back cover to hold them. The size sheet required, in one case, measures 24 x 15 in. Size 5 x 7½ in. Pp. 62. Price $2.00. Published by the Engineering Magazine Co., New York, or may be had through the book department of The Heating and Ventilating Magazine.

Mechanical Equipment of School Buildings, by Harold L. Alt, is a compilation, in book form, of a series of articles that appeared recently in the *American School Board Journal*. The book expresses throughout the author's own experience as a designing and supervising engineer. Chapters are included on heating and ventilation, ducts and flues, plumbing fixtures, water supply systems, fire protection, drinking water, sewage disposal, the school power plant, the school swimming pool, electric lighting and vacuum cleaning. Variations in approved, up-to-date practice are allotted equal prominence giving the reader his choice in the final selection. The chapter on "School Power Plant," emphasizes the advantages of such plants. Illustrations are given of the equipment of a typical power plant installed in 1915 in a high school in an Eastern city, which has operated successfully and economically. Size 8 x 10¾ in. Pp. 108 and index. Price, $2.50. Published by the Bruce Publishing Co., Milwaukee, Wis., or may be had through the book department of The Heating and Venitlating Magazine.

NEW DEVICES

Another New Radiator Humidifier.

The accompanying illustrations show the construction of the Eureka humidifier which has been placed on the market by the Eureka Blotter Bath Co., Chicago, Ill. It comprises a metal receptacle, a frame and a vapor stone, the surface of which is made of ground stone and charcoal and forms an evaporating surface for the moisture held in the pan. It is pointed out that the dehumidifying properties of this device are a notable feature, it having been found that excess moisture in the air will be absorbed by the stone. There is a filling funnel in the center so arranged that the pan can be easily filled without removing the device from the radiator.



EUREKA HUMIDIFIER, SHOWING VAPOR STONE AND FILLER.

BACK OF EUREKA HUMIDIFIER.

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Trade Literature.

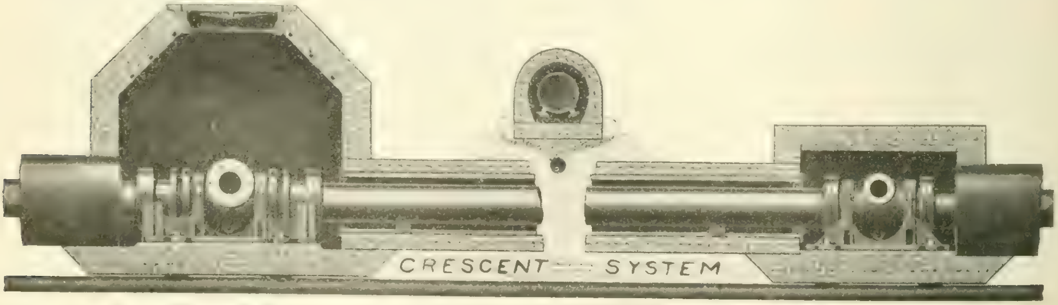
Molby Magazine-Feed Down-Draft Boilers, made by the Molby Boiler Co., New York, under the Surrell patents, are featured in a new catalogue, which shows the latest types of construction. This boiler, which is made of cast-iron, is manufactured in three sizes, 26-in., 31-in. and 47-in. The 26-in. series differs from the others only in having one magazine, while the 31-in. and 47-in. have two magazines, one on each side. One advantage of the two-magazine feature is that it permits one or two fires to be carried as desired. All of these boilers, it is pointed out, burn the cheaper grades of fuel, such as pea coal or bituminous nut or slack under 2-in. in diameter, and without smoke. The fire is all on one grate thus preventing fresh bituminous coal falling through holes in the fire to the ash pit or to a lower zone where they might create smoke. The catalogue is accompanied by complete data tables for the entire line, both water and steam. Size 4 x 9 in. Pp. 16.

There is a Radiator in This Room. Can You Find It? is the title of a circular devoted to the Ja-Nar', the "automatic heat control," manufactured by the Fulton Co., Knoxville, Tenn. The illustration referred to shows a sitting room with the window radiator concealed from view by this interesting radiator enclosure and temperature regulator. The Ja-Nar' is made in different finishes to match the furnishing or the woodwork of the room. It consists of an insulated cover, with the necessary regulating mechanism for opening and closing the louvres in the casing by which the heat emission is controlled. The point is emphasized that no plumbing or steam fitting is necessary in installing the Ja-Nar', it being simply placed over the radiator. There is also no operating expense. No electric current is used and there are, therefore, no batteries to renew.

Uses of "National" Pipe, illustrating by photographs hundreds of uses for this product, is the subject of a recent bulletin (No. 27) issued by the National Tube Co., Pittsburgh, Pa. "Who will attempt to compile a complete list of the uses of wrought pipe?" asks the bulletin and the magnitude of such an undertaking is realized when reference is made to the illustrations which show literally over 1,000 such applications. A foreword in the bulletin gives a summary of the rise of "National" pipe, which dates from 1868. During the ensuing fifty years, adds the bulletin, the annual manufacturing capacity has increased to 1,500,000 tons of "National" pipe and allied tubular products, soon to be increased to another 500,000 tons yearly by the capacity of the new self-contained $25,000,000 National Tube Company mill, at Gary, Ind. A brief review is also given of the researches and experiments that led the company to abandon the manufacture of wrought-iron pipe in favor of wrought steel. The bulletin includes some 15 pages of pipe data. Size 8½ x 11 in. (standard). Pp. 52.

Crescent System of Modern Heating, for central stations, universities, industrial plants and public buildings, is the subject of a cloth-covered catalogue, issued by the manufacturers, W. H. Pearce & Co., Chicago, Ill. This system consists of especially-designed conduits, expansion sleeves, anchors, traps, valves, ball-bearings, ball and angle joints, pipe collars, pipe insulation and other devices used on the inside of buildings, such as valves, heaters and temperature regulators. Illustrations and descriptions of these devices, together with numerous views of typical installations give a comprehensive idea of the advantages of the Crescent system. Size 6 x 9 in. (standard). Pp. 60.

Modern Heating By Means of Pressweld Radiation is the title of a newly-issued catalogue devoted to the Pressweld line of "radio" alloy sheet metal radiators. Pressweld radiation, it is stated, "has made good and has been endorsed by the nation's leading engineer and architects." Illustrations and descriptive data are given of several of the standard types and sizes of Pressweld units supplied, also a broken view showing the points of welding at the seams and between sections. Full details regarding tappings and dimensions are included, the

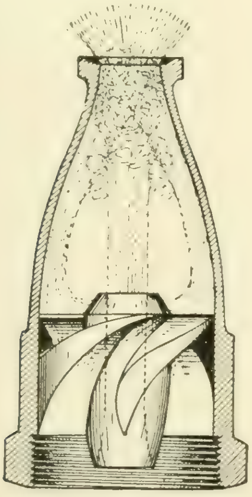


CRESCENT CONDUIT CONSTRUCTION FOR UNDEGROUND PIPE LINES.

catalogue closing with a report of an interesting corrosion test, made last year at the Detroit Testing Laboratory. In this test a specimen of special radio alloy metal was compared with specimens of mild steel and cast-iron, with the following results:

Specimen No. 1—Cast Iron:
Shows a loss in weight after 24 hours immersion—
In 10% Hydrochloric Acid Solution 18.08%
In 10% Sulphuric Acid Solution ..18.47%
Specimen No. 2—Mild Steel:
Shows a loss in weight after 24 hours immersion—
In 10% Hydrochloric Acid Solution 4.37%
In 10% Sulphuric Acid Solution .. 6.50%
Specimen No. 3—Special Radio Alloy Metal:
Shows a loss in weight after 24 hours immersion:
In 10% Hydrochloric Acid Solution 1.06%
In 10% Sulphuric Acid Solution .. 0.36%

The conditions of temperature solution (70° F.) length of immersion and strength of acid were identical in all cases. These comparative acid and corrosion tests, it is pointed out, demonstrate a decided superiority in favor of the special alloy metal, so far as resistance to corrosion is concerned. The Pressweld line is manufactured by the American Pressweld Radiator Corporation, Detroit, Mich. Size of catalogue, 5¼ x 8¾ in. Pp. 24.


SPRACO NOZZLE

Spraco Products, including spray cooling equipment, air washing and cooling equipment and paint spraying equipment, are presented in a new catalogue (Bulletin 501) issued by the Spray Engineering Co., Boston, Mass. In a description of the salient features and design of the Spraco nozzle it is pointed out that a part of the liquid in passing through the nozzle is given a rapid rotating motion by the turbine center, and is driven forth through the orifice in the form of a dense, uniform spray by the centrifugal driving jet. This jet in impinging on the rotating water in the mixing chamber near the orifice entirely fills the center of the spray, giving it a solid conical formation of equal density across its section. Size 8 x 11 in. Pp. 16.

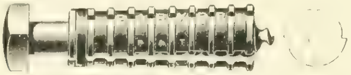
SOLID CONICAL FORMATION PRODUCED BY SPRACO NOZZLE

HOLLOW CONICAL FORMATION

Blackman and Duplex Cone Fans, described as the outcome of thirty years' work, are featured in a carefully-compiled catalogue (No. 180) received from Howard & Morse, New York. Numerous tables covering the different sizes are included, showing horse-power requirements and speeds, all of which are guaranteed by the manufacturers. The concluding section of the catalogue is devoted to the Duplex cone fan for maintaining any pressure involved in any plenum or exhaust system of heating or ventilation. Size 8 x 11 in. (standard). Pp. 24.

"**National Preparedness**," is the title of a clever wall-hanger calendar, containing an illustrated poem by Berton Braley, glorifying the part played by "National" pipe in the present age of the generation and transmission of power. The theme of the poem is well-expressed in the line, "Framework of civilization is wrought of it." The hanger is issued by the National Tube Co., Pittsburgh, Pa.

Parker Expansion Bolts, made by the Parker Supply Co., New York, are called to the attention of the trade in a series of three blanket circulars, bringing out the important points of this line. The line includes the lag-screw type, the machine bolt type (single and double and with bottom bearing) and the wood-screw type. The first bulletin presents the complete line, while the second bulletin lays emphasis on the projections on the shield which prevent it from turning in the hole while the bolt is being put in. It is stated that the projections bite deep into the masonry in opposite directions, resulting in a firm grip. Circular No. 3 calls attention to the clear-cut castings from which the Parker expansion shield is assembled. This, it is stated, comes from using better pig iron, molding by machine, annealing with great care and cleaning by sand-blasting.

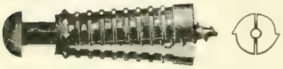


Lag Screw Type

Machine Bolt Type Single

Machine Bolt Type—Double

Machine Bolt Type—Bottom-Bearing



Wood Screw Type

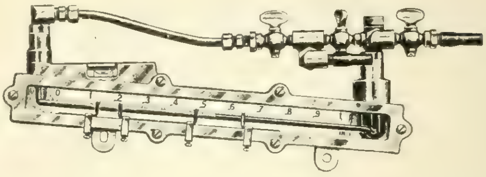
PARKER EXPANSION BOLTS.

◆

Ellison Draft Gauges.

A line of 15 types, comprising in all 200 different gauges, is now included in the product of Lewis M. Ellison, 214 West Kinzie St., Chicago, Ill. Among the constructive features, which, it is stated, give a remarkable degree of accuracy to this type of gauge, are that they have no mechanism for multiplying the scale of indications, but are equipped with an inclined tube with oil of constant capillary attraction, lubricating the surfaces and traveling without friction over a single-reading scale, self-correcting for capillary attraction and specific gravity, indicating equivalent water pressures direct without factor. By this arrangement it is claimed at that an accuracy is obtained never attained in any other form, type or make of draft gauge.

All model 1916 draft gauges are made with self-lining ears, designed to relieve the gauges of twisting strains. They are ordinarily made of aluminum, with scales of white metal in black graduations. The full line includes the open type and cover type, and several differential types, including one whereby the furnace draft, the flue draft or the differential between the flue and furnace is independently indicated on a single-tube gauge. The Ellison line is described in a 40-page booklet, recently issued by the manufacturer.



ELLISON COMBINATION DIFFERENTIAL DRAFT GAUGE.

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Sylphon Regitherm Manufactured by the Fulton Company.

The Ideal Sylphon regitherm which, as described in these columns last month, is used with success in controlling the temperature in central station heating systems, is manufactured by the Fulton Company, Knoxville, Tenn., under patents taken out by W. M. Fulton, and not by the American Radiator Company, as was stated in the article. The American Radiator Company acts as exclusive distributor for the device.

◆

Trade Journals Pledge Services to the Government.

Up to date 277 class journals in the United States have pledged their services to the Government in giving editorial co-operation and free advertising space. The telegrams offering this co-operation were taken to Washington April 17 by a committee of the New York Business Publishers' Asociation, headed by Arthur J. Baldwin, of New York. They were received by Secretary of War Daniels and by other officials in the War Department. It is proposed to keep closely in touch with the Government in its work and to secure wide publication of matters for which the government desires extended publicity.

◆

Providing for War Dependents.

In a letter to the Chamber of Commerce of the United States, Secretary of War Baker urges that employers of labor make only temporary arrangements with their employees until such time when it is hoped some uniform system can be suggested which will adequately take care of the situation. It was found that, in some cases, some employers were paying full wages in addition to the army compensation. Another solution was paying the difference between the army wage and that previously received by the employees. The Chamber of Commerce will immediately organize a special committee to make an investigation of this matter and the secretary of war has asked that the results of such an investigation be reported as soon as possible to the War Department, together with such advice as the commitee feels authorized to give.

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BULLETIN OF THE NATIONAL DISTRICT HEATING ASSOCIATION for April, 1917, features the programme of the forthcoming convention of the association in Detroit, June 12-15. There is also a letter from President Byron T. Gifford calling attention to the effect on the central station heating industry of the increased costs of materials, fuels and labor requiring a revision of past cost records and rate schedules. The rate question, he states, will be an important subject of discussion at the convention. The leading article is the description of the "New Station of the New York Steam Company," written by Claude Hartford, one of the company's sales engineers.

◆

American Heating Specialty Co., Peru, Ind., has taken over the business of the Tillman Heating Devices Co., of Indianapolis. The company is also placing a new tank-in-basement method of hot water heating on the market.

◆

Central Station Heating Notes.

Ishpeming, Mich.—President William Leininger of the Ishpeming Advancement Association is agitating the proposition of establishing a central station heating system for the business district of Ishpeming. A canvass has already been made of the downtown section, with favorable results.

Virginia, Minn.—The city council has voted favorably on a recomemndation from the water and light commission that the city build a municipal heating plant. It was decided to issue certificates of indebtedness to the amount of $110,000 to pay for the plant which, it is claimed, will pay for itself in 15 years.

Cleveland, O.—Utilities Director Farrell has instructed the water department engineers to investigate the feasibility of using the Fairmount steam heating plant for the manufacture of ice during the summer months.

Providence, R. I.—Work is under way on plans for the central heating plant to be built to supply the new high school building and the three present structures. Bids on the high school will await the completion of the heating plans, according to Chairman Percy A. Harden, of the city council property commitee, as the erection of both buildings at the same time will be necessary since the high school will be without heat until the central plant is in operation.

New Ulm, Minn.—In a report submitted to the city council by F. W. Johnson and A. J. Vogel, directors of the New Ulm Heating Company, it is estimated that the total cost of the municipal heating plant is $26,286.

Des Moines, Ia.—The heating franchise asked for by the Des Moines Electric Company, which was submitted to the voters at a special election March 26, passed successfully by a margin of 1331 votes. The proposal was favored by the Chamber of Commerce but was opposed by organized labor, a campaign against the measure being conducted by the Trades and Labor Assembly. Following the election a delegation from that organization visited the council with a demand that an investigation be made of the election and rumors of a grand jury investigation were heard. The poll book for the nine precincts of the First Ward were found missing. The contest, if successful, might invalidate not only the franchise election, but also the vote on the bond issue as well.

Indianapolis, Ind.—Construction work will begin shortly on the new six-story concrete and steel power plant of the Indianapolis Light & Heat Company, to be erected near its present plant on Kentucky Avenue. The building will be 200 ft.

long and 100 ft. wide and wil cost $200,000. It will be completed by October 1. When the new building is finished, the present power house will be torn down and the second half of the proposed plant will be built. The entire building will house equipment sufficient to maintain two 30,000 H.P. units, a boiler room capacity for 800 H.P. steam boilers and space for other equipment to make up a complete power plant. The new boilers will have a limit of 250 lbs. steam pressure and 200° F. superheat.

Kansas City, Kan.—Work on the foundation for the $350,000 addition to the Kansas City Light & Power Company's heating plant is completed and construction on the building itself will start immediately. The addition will be completed by next fall.

Davenport, Ia.—The People's Light Company, which recently took over the heating franchise of the Davenport Gas & Electric Company, will spend $100,000 this summer in the reconstruction of the system, including the steam mains.

◆

Byron T. Gifford Opens Consulting Engineering Offices.

Byron T. Gifford, president of the National District Heating Association, has opened offices as consulting engineer in the Grand Rapids Savings Bank Building, Grand Rapids, Mich. Mr. Gifford and his associates are making a specialty of rate studies and investigations relative to public utility companies and especially in connection with central heating companies which at this time are particularly interested in rate questions.

Mr. Gifford's experience has been broad and he is well-known in his profession. Seymour W. Cheney is associated with Mr. Gifford. Mr. Cheney has been engaged in public utility work for twelve years in the design and operation of properties.

Both Mr. Gifford and Mr. Cheney were formerly associated as chief engineer and assistant engineer, respectively, of the American Public Utilities Company.

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Standard Heating and Ventilating Data Sheets.

Previously-published data sheets, similar to those appearing herewith, are as follows:

FEBRUARY, 1917 ISSUE.

No. 1—B.T.U. Losses.
No. 1-A—B.T.U. Losses—Brick.
No. 1-B—B.T.U. Losses—Stone and Concrete.
No. 1-C—B.T.U. Losses—Combinations.

MARCH, 1917 ISSUE.

No. 1-D—B.T.U. Losses—Tile.
No. 1-E—B.T.U. Losses—Frame Construction.
No. 1-F—B.T.U. Loses—Glass, Skylight and Miscellaneous.
No. 1-G—B.T.U. Losses—Ceiling, Floor and Roof.

APRIL, 1917 ISSUE.

No. 2—Exposure.
No. 3—Leakage.
No. 4—Temperature Range.
No. 4-A—Temperature Range.

Copies of these sheets, printed, separately, on one side only, may be obtained at 5 cents each. The attention of readers is also called to the special binder for holding these sheets. The price of the binder is $1.00, postpaid.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, OF THE HEATING AND VENTILATING MAGAZINE, published monthly at Cooperstown, N. Y., for April 1, 1917.

State of New York, } ss.
County of New York. }

Before me, a notary in and for the State aforesaid, personally appeared A. S. Armagnac, who, having been duly sworn according to law, deposes and says that he is the Editor of The Heating and Ventilating Magazine, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Heating and Ventilating Magazine Co., 1123 Broadway, New York.
Editor, A. S. Armagnac, 1123 Broadway, New York.
Managing Editor, None.
Business Manager, Gustave Petersen, 1123 Broadway, New York.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)

Heating and Ventilating Magazine Co., 1123 Broadway, New York.
A. S. Armagnac, 1123 Broadway, New York.
Gustave Petersen, 1123 Broadway, New York.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:

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4. That the two paragraphs net above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner and this affiant has no reason to believe that any other person, association or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

A. S. ARMAGNAC, Editor.

Sworn to and subscribed before me this 29th day of March, 1917.

A. L. Scantlebury, No. 173,
Notary Public, Kings County.
Certificate filed in New York County.
(My commission expires, March 30, 1919.)

COMPUTING HEAT LOSSES.

There is only one method which can produce accurate results in the computation of heat losses and that is the B.T.U. system. The accuracy of the results attained by using B.T.U. is only limited by the accuracy of the designer in computing the areas of his surfaces and the correctness of his factors for the given construction. All rules of thumb give approximate results only and these usually for certain standard-sized rooms of regular construction.

Heat will gradually transfer from a warm object to a cold one until the temperature of each is the same at which time the interchange of heat ceases. Thus a warm room loses heat to a colder one, to the outside air, to the attic, or to any other adjacent space where the temperature is lower than that maintained in the room.

A room will also absorb heat from an adjacent apartment if the apartment is kept at a higher temperature than the room. For this reason cold attics over warm rooms are generally figured as being at 40° F. if the rooms are 70° and the outside temperature zero. Similarly unheated space under a room is generally considered as being at 35° F. under similar conditions.

Thus to get the entire B.T.U. loss for a room *all* the surfaces separating the room from colder conditions must be counted as positive heat losses (the exact amount being the area exposed times the heat loss co-efficient CE times the difference in temperature between the two spaces) and *all* the surfaces separating the room from warmer spaces must be similarly figured as negative losses, the algebraic sum of the two giving the net radiation loss for southern exposure.

Outside walls and glass must have the exposure factor figured but on inside walls, glass, ceilings and floors it is not necessary to consider the exposure factor.

To the net transmission loss, with the proper increase for exposure must be added the leakage loss—if the room is unventilated—and the total will be the gross loss upon which to base the required radiator surface.

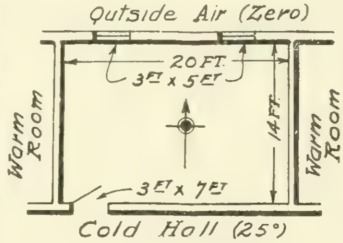
Briefly these may be summarized as follows:

SUMMARY OF B.T.U. METHOD OF HEAT LOSS CALCULATION.

1. Compute all wall surface exposed to the outside air in one direction only.
2. Compute all the glass and door surface in the same wall.
3. Subtract the glass and door surface from the gross wall surface leaving the net wall surface.
4. Multiply the glass surface by the proper factor for the temperature difference assumed.
5. Multiply the net wall surface by its proper factor similarly.
6. Add the wall and glass loss and increase for exposure as per the percentages given on Sheet No. 2.
7. Follow similar procedure for other outside walls.
8. Compute inside walls, ceilings, and floors where spaces on the other side are at temperatures different from the assumed room temperature, and multiply by proper factor for each construction and its respective temperature difference, making spaces warmer than the room negative losses.
9. Take the algebraic sum of all the losses computed and add leakage loss if room is unventilated. This will be the total B.T.U. loss.

Example of Computing by B.T.U. Method.

Problem: A room 14 ft. x 20 ft. x 10 ft. high, with only reasonable exposure, is to be heated to 70° F. in zero weather; it has a warm cellar below and a cold attic above; the construction is frame and the plan, as shown herewith.



The outside wall area is 20 ft. × 10 ft. .... = 200 sq. ft.
The window area is 5 ft. × 3 ft. .... = 30 sq. ft.

Net area .... = 170 sq. ft.

Frame house: loss for clapboards, paper, sheathing, lath and plaster for 70° — 0°, or 70° temperature difference = 16 B.T.U. (See Sheet No. 1-E.) Loss for glass, single thick, for 70° = 70 B.T.U. (See Sheet No. 1-F.)

Wall loss = 170 sq. ft. × 16 B.T.U. = 2720 B.T.U.
Glass loss = 30 sq. ft. × 70 B.T.U. = 2100 B.T.U.

Sum (for southern exposure) .... = 4820 B.T.U.

Room is unventilated and has north exposure. Therefore, the exposure factor (Sheet No. 2) is 15%, or 723 B.T.U. On the inside walls, all are warm except the hall wall which is 20 ft. × 10 ft. gross, or 200 sq. ft. The door equals 3 ft. × 7 ft., or 21 sq. ft. The net wall equals 179 sq. ft. Glass loss for 45° F. (Sheet No. 1-F) = 45 B.T.U. Wall loss for 45° F., for plastered stud walls (Sheet No. 1-E) = 15 B.T.U.

Inside wall loss = 179 × 15 = 2635 B.T.U.
Inside glass loss = 21 × 45 = 945 B.T.U.

Sum of inside wall losses = 3630 B.T.U.

As the cellar is warm no loss is figured on the floor, but with a cold ceiling (at 40° attic space above the ceiling) the area is 14 ft. × 20 ft. = 280 sq. ft. and the factor for 35° difference (Sheet No. 1-G) is 9 B.T.U. = 280 × 9 = 2520 B.T.U.

At one air change the cubic contents of 14 ft. × 20 ft. × 10 ft. = 2800 cu. ft. which at 70° F. (See Sheet No. 3) = 2800 × 1.27 = 3556 B.T.U. for leakage.

The total B.T.U. loss equals the sum of all the various losses computed, or:

	B.T.U.
Outside wall and glass	4820
Exposure	723
Inside wall and glass................	3630
Ceiling loss	2520
Leakage	3556
	15249 Total B.T.U. Loss.

B. T. U. EXAMPLE OF COMPUTATION | NO. 6

VENTILATION.

Ventilation consists briefly of all the artificial air conditioning necessary to maintain the air inside of a building in a condition desirable for certain purposes (either for breathing or to suit given manufacturing processes) and at such standards as may be regarded as desirable.

The most common form of ventilation is that used to furnish an air supply (and sometimes an air exhaust) for the occupants of a building (without which the interior air would become foul) and also for the purpose of removing objectionable odors—such as in kitchens, restaurants and toilet rooms.

In past years the amount of carbonic acid in the air has been used to determine the comparative degree of purity even though it has been understood that carbonic acid itself is not dangerous. This is because pure air seldom contains over 4 parts in 10,000, while in air used for breathing purposes the number of parts rises rapidly and almost proportionately with the other impurities contained in exhaled air. Therefore, a statement of the amount of carbonic acid present in a given sample of air—a measurement comparatively easy to make—may be taken as indicative of the amount of other impurities also.

Each person gives off about 0.6 cu. ft. of carbonic acid per hour. If the fresh air entering a room has 4 parts in 10,000 of carbonic acid and the limit in the room is desired to be kept below a certain number of parts the number of cubic feet per minute per occupant must be not less than as follows

Limit of Parts of Carbonic Acid in 10,000 Parts of Air	Cubic Feet of Fresh Air Necessary per Minute Per Occupant.
5	133
6	67
7	44
8	33
9	27
10	22
11	19
12	17

While these are the theoretical amounts of air required, some consideration must be shown for the quantity of air contained in the room at the beginning of its occupancy and also the length of time the room is occupied. Thus, a church where the services are short and the volume of fresh air large at the beginning requires less air to ventilate than a moving picture theater running continuously for ten hours a day and usually in more or less cramped quarters.

Sheets Nos. 6-A to 6-E inclusive give the recommended number of air changes for various rooms in different types of buildings.

VENTILATION.

Number of Air Changes.

The table below shows the changes of air per hour, or the cubic feet per minute (C.F.M.) per occupant, recommended for various rooms in theatres, churches, moving picture halls, assembly halls and other places of congregation.

	Supply		Exhaust	
Room	C.F.M. Per Occupant.	Minimum No. of Air Changes.	C.F.M. Per Occupant.	Minimum No. of Air Changes.
Churches				
Auditorium	20	...	20	...
Banquet	30	8	30	8
Coat and Locker	none	...	...	...
Sunday School	30	...	30	...
Social Rooms	30	8	30	8
Toilets	...	none	none	8 to 10
Theatres				
Auditorium	30	...	30	...
Lobbies	...	10	...	...
Retiring Rooms	...	4	...	4
Smoking Rooms	...	6	...	10 to 12
Toilets	...	none	...	8 to 10

The Heating and Ventilating Magazine

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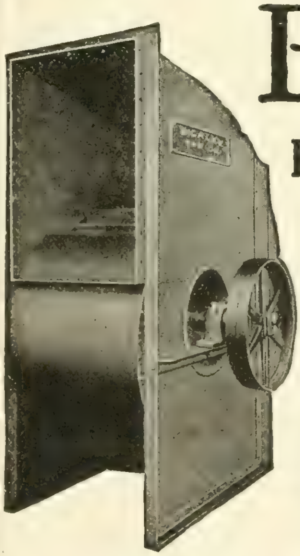

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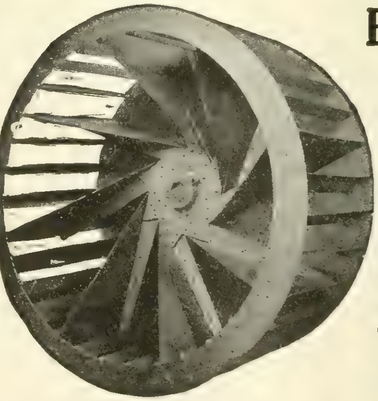

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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. JUNE, 1917 1123 Broadway, New York

Experimental Plant of the New York State Commission on Ventilation in School No. 51 New York City

The New York State Commission on Ventilation, which has been pursuing its investigations since 1913 has but recently completed the trying out of a second set of experiments. These were based more on actual operating conditions, than those of the laboratory, as was the case in the first set of experiments made at the Biological Laboratories of the College of the City of New York. In order to secure an environment of the most practical, every-day nature these tests were made under ordinary operating conditions such as are attained in the common public school building. For this purpose the use of two rooms in Public School No. 51, situated in the Bronx, New York City, was secured from the New York Board of Education through the efforts of its chief heating and ventilating engineer, Frank G. McCann. These rooms are on the second floor and consist of rooms Nos. 203, and 205, each having 48 sittings and a teacher's desk, making a total of 49 occupants each when fully occupied.

Fig. 1 shows the general arrangement of the two rooms and their close similarity; the black dots in Room No. 205 indicate the location of floor outlets, more clearly shown in Fig. 3.

DETERMINING EFFECTS OF RECIRCULATION.

One of the principal objects of these experiments was to determine more closely the saving and physical and mental effects of recirculation of vitiated air and to facilitate this, two rooms were selected as closely identical in size, window area, seating and other arrangement as was possible. Each room was supplied by a special ventilating apparatus which was entirely separate and distinct from that supplying the other room, and

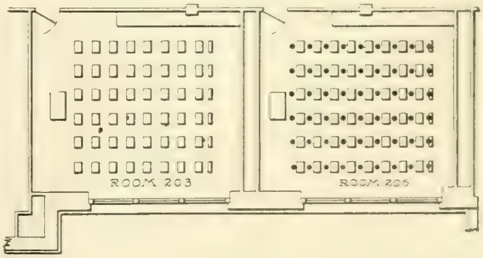

FIG. I—ARRANGEMENT OF TWO ROOMS USED BY THE NEW YORK STATE VENTILATION COMMISSION FOR EXPERIMENTAL PURPOSES.

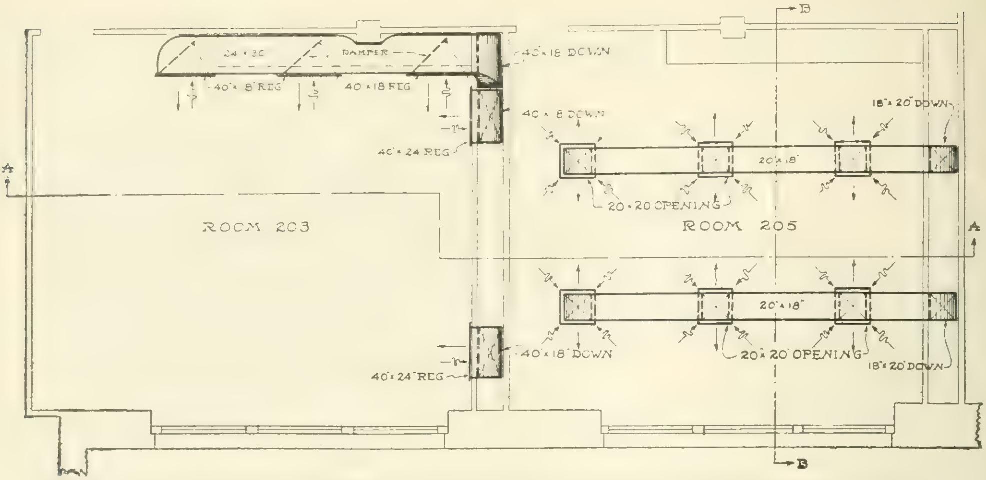

FIG. 2—PLAN OF UPPER REGISTERS AND DUCTS NEAR CEILING OF EXPERIMENTAL ROOMS.

to still further vary the combinations the air inlets and outlets were arranged differently in the two rooms.

The ventilating equipment was designed by the R. D. Kimball Company and installed by Child & Scott, heating contractors, under the supervision of H. L. Alt, superintendent for the Kimball Company. The registers were located at various points indicated in the ilustrations. In Room No. 203 three registers 18 in. × 40 in. were located along the corridor wall with the bottoms 8 ft. above the floor. These were connected to one duct. Beneath these registers and at the floor were set three other double registers of lattice pattern, two of these coming in the face of the wardrobe and one in a false extension of the wardrobe at the left end. These were also connected to the same duct, but were supplied with dampers so that either the upper set of registers or the lower set of openings might be used as desired.

Across the back of the room were set two more registers 8 ft. above the floor, with two other registers directly below them at the floor level; these are illustrated in Fig. 6. The registers near the windows were connected into a single duct with dampers so that either top or bottom register could be used and those

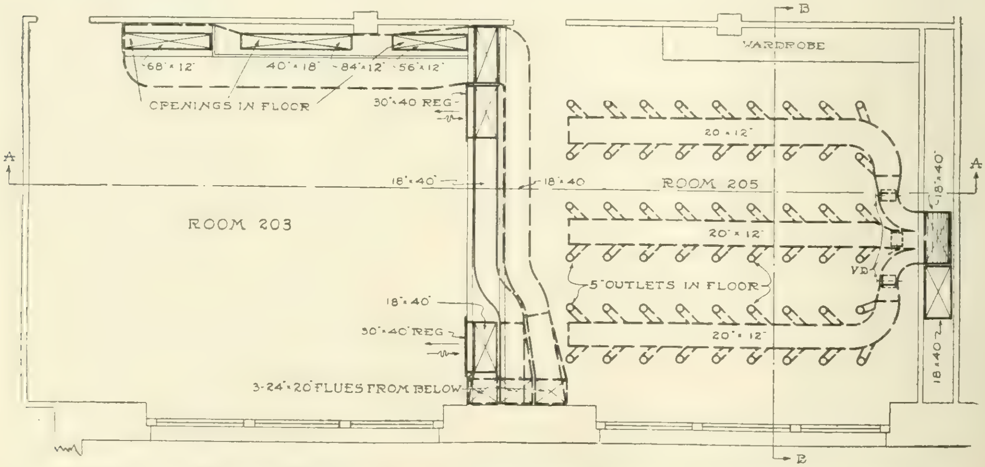

FIG. 3—LOWER REGISTERS AND DUCTS AT OR BELOW FLOOR OF EXPERIMENTAL ROOMS.

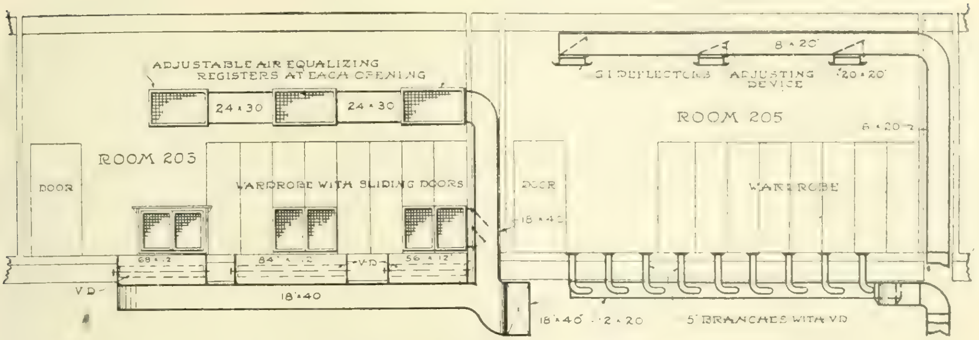

FIG. 4—ELEVATION ON LINE A-A OF FIGS. 2 AND 3.

toward the corridor were similarly treated. This made three separate ducts for Room No. 203 of which any or all could be made top or bottom registers and supply or exhaust as desired.

CEILING OUTLETS IN ONE ROOM.

In Room No. 205 a different scheme was followed out, no inlets being provided in this room in the wall; on the contrary six ceiling outlets 20 in. × 20 in. were provided, these being arranged on the ceiling so as to be in the centre of each of six equal rectangulars into which the room was divided, the rectangulars being based on the location of seats. These outlets are connected in threes to an 18 in. × 20 in. flue, the two flues being united into a 40 in. × 18 in. flue, as shown in Fig. 5, and carried back to the apparatus in the basement. In the floor at each seat is provided a circular opening into which mushrooms or goosenecks could be inserted so as to give each pupil an individual fresh air supply or exhaust as desired. These were covered by square beveled flush wooden covers which may be placed over the outlets if it is desired to eliminate all floor ventilation. These openings are connected into three 12 in. × 20 in. ducts run on the ceiling of the playroom which comes directly below the two experimental rooms as shown in Figs. 4 and 5, this duct being carried back to the apparatus and making two flues from Room No. 205.

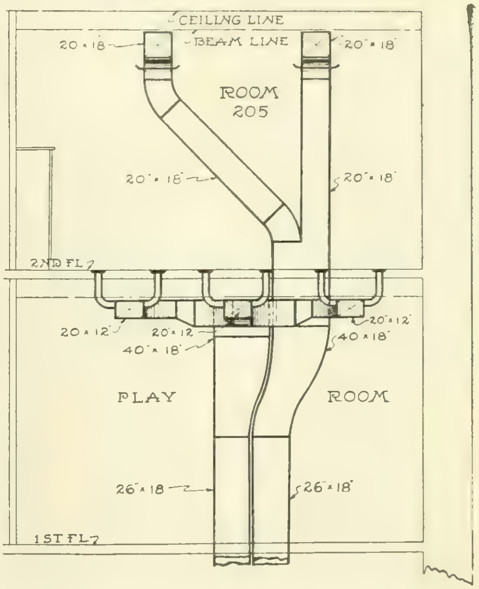

FIG. 5—ELEVATION ON LINE B-B OF FIGS. 2 AND 3.

In the basement each room is connected to its own ventilation equipment, as illustrated in the plan and elevation, Fig. 10; apparatus for each consists of a fresh air suction chamber SC; a tempering heater, TH, consisting of two rows of five sections each of 40-in. narrow Vento heaters, 4⅝ in center-to-center; a Type A Carrier air washer, AW, 7 ft. long, 2 ft. 9 in. wide and 4 ft. high, capable of handling 2,500 cu. ft. per minute; a heater, H, consisting of one row of 5 sections of Vento heater similar to that already described; a No. 4 Sturtevant Multi-vane supply fan, SF, and operated by direct-connected 1½

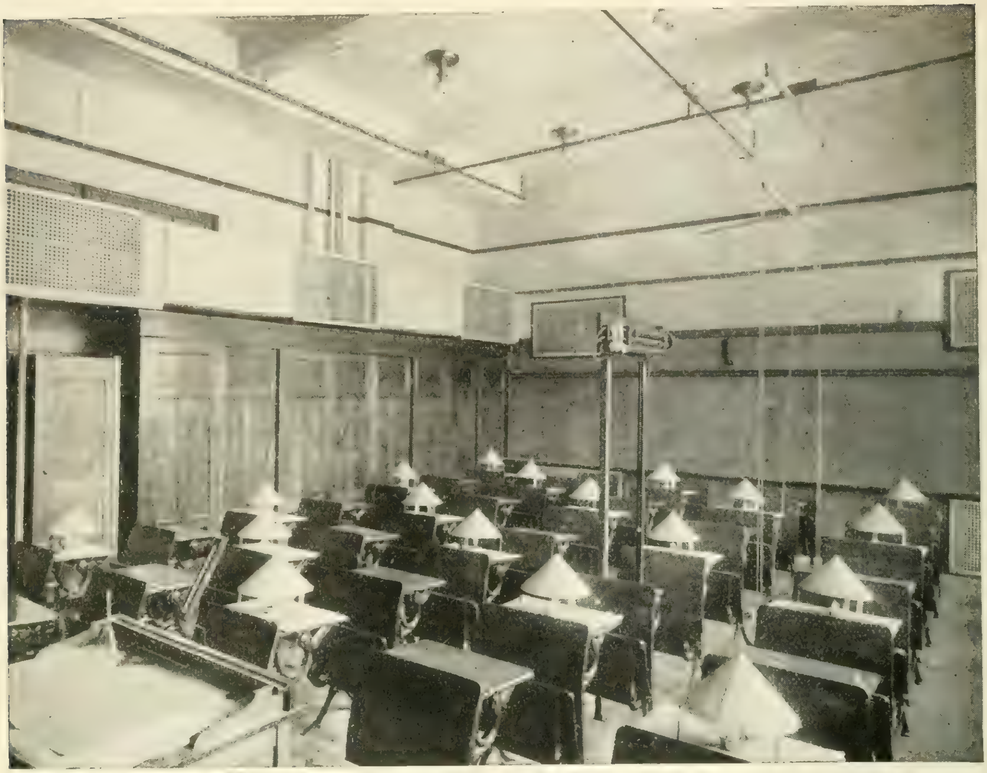

FIG. 6—VIEW OF ROOM NO. 203 LOOKING TOWARDS BACK OF ROOM.

H. P. direct current Sprague motor, and a re-heater, RH, consisting of two rows of Vento, being a duplicate of the tempering heater, already described.

The exhaust fan, EF, is a No. 4 Sturtevant Multi-vane fan similar to the supply fans described and is direct connected to 1 H. P., 230-volt direct-current Sprague motor with a No. 2150 Cutler-Hammer controller. All sheet metal work is No. 24 gauge galvanized sheet iron with suitable stiffeners.

Each coil has a 1½ in. steam supply and 1 in. return connection, the returns being taken through a thermostatic trap and thrown away into the sewer. The supply connections to the heaters have gate and diaphragm valves with Johnson thermostats and automatic control while the return connections have strainers and Webster thermostatic valves. Steam is supplied to the system through

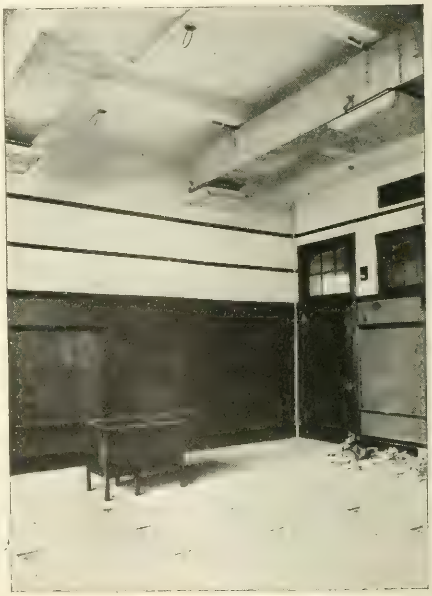

FIG. 7—VIEW IN ROOM NO. 205, LOOKING TOWARD FRONT, SHOWING CEILING DUCT AND OUTLETS AND FLOOR OPENINGS.

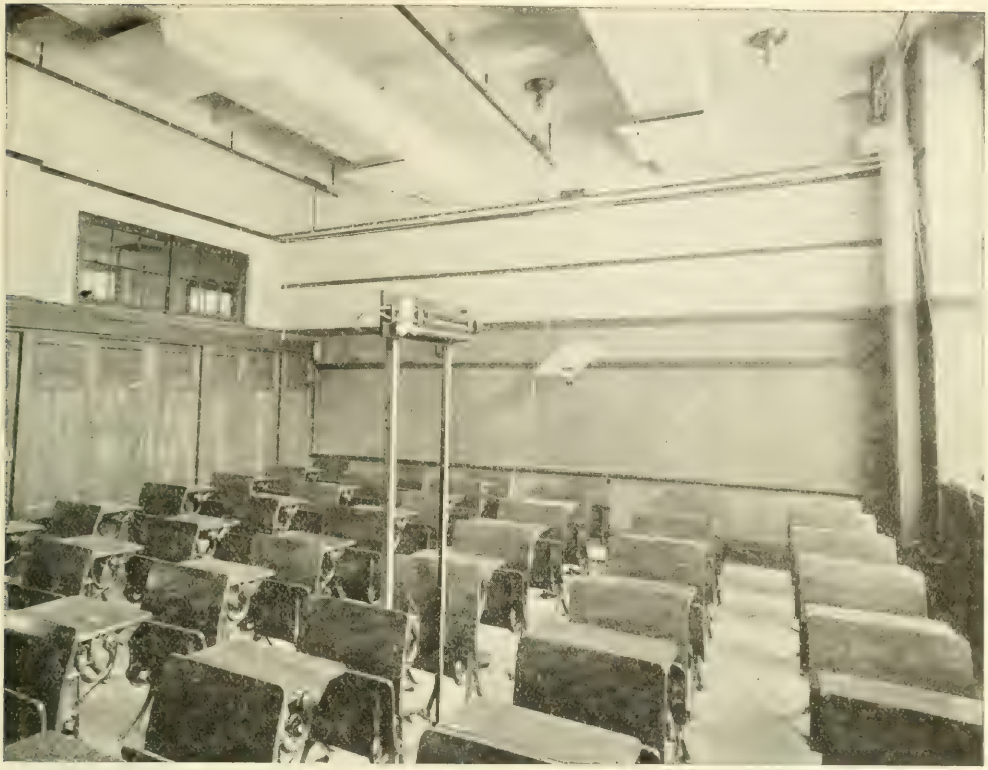

FIG. 8—VIEW OF ROOM NO. 205, LOOKING TOWARD THE REAR.

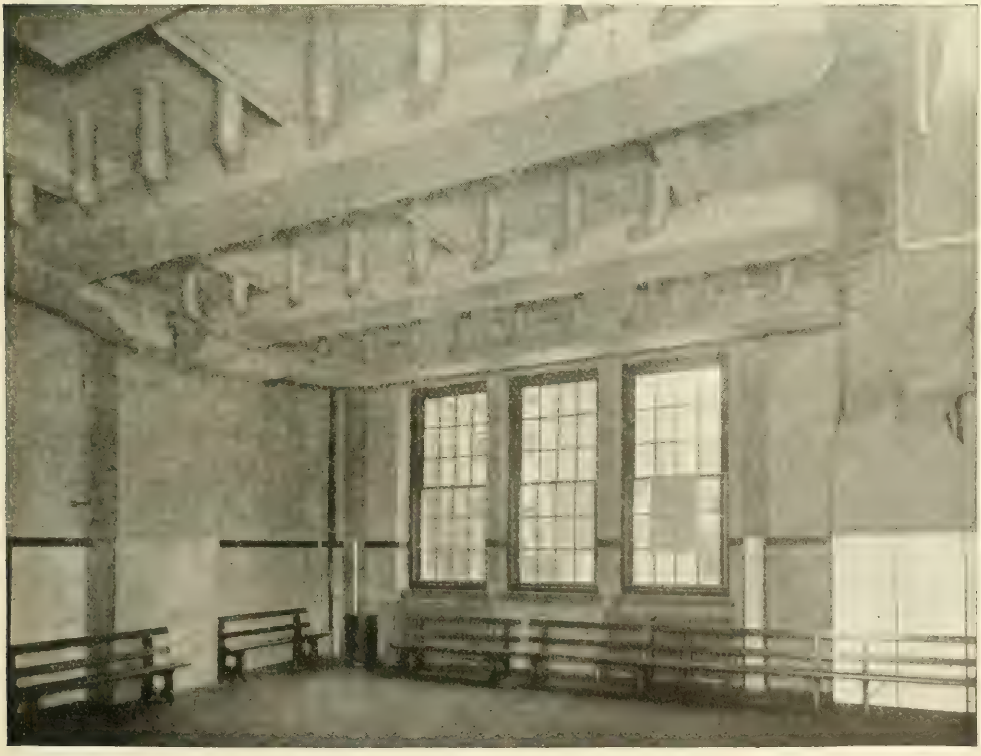

FIG. 9—METHOD OF CARRYING THE DUCTS ACROSS THE CEILING OF THE PLAYROOM BELOW THE EXPERIMENTAL ROOMS AND OF DROPPING THE FLUES DOWN TO THE BASEMENT APPARATUS ROOM.

a 3 in. Standard Regulator reducing valve, which is a valve of the diaphragm type placed on a branch from the steam main furnishing high pressure steam to the fan engines that operate the school fans which ventilate the balance of the building.

The temperature control system consists of one duct thermostat situated in the cold air intake which is set at 35° and controls the 1½-in. diaphragm valve on the first row of the tempering heater. A second duct thermostat is situated between the washer, AW, and heater, H, this being set at 40° and controlling the 1½- in. diaphragm valve on the second row of the tempering heater. A third thermostat is placed in the fresh air fan intake set at 60° and controlling the 1½-in. diaphragm valve on the heater; a fourth thermostat is located in the top plenum chamber, HA, set at 70° and controlling the 1½-in. diaphragm valve on the first row of the re-heater and a fifth thermostat in the top plenum chamber, HA, set at 80° and controlling the 1½-in. diaphragm valve on the second row of the re-heater. There is also installed one room thermostat in the class room controlling the mixing dampers in the

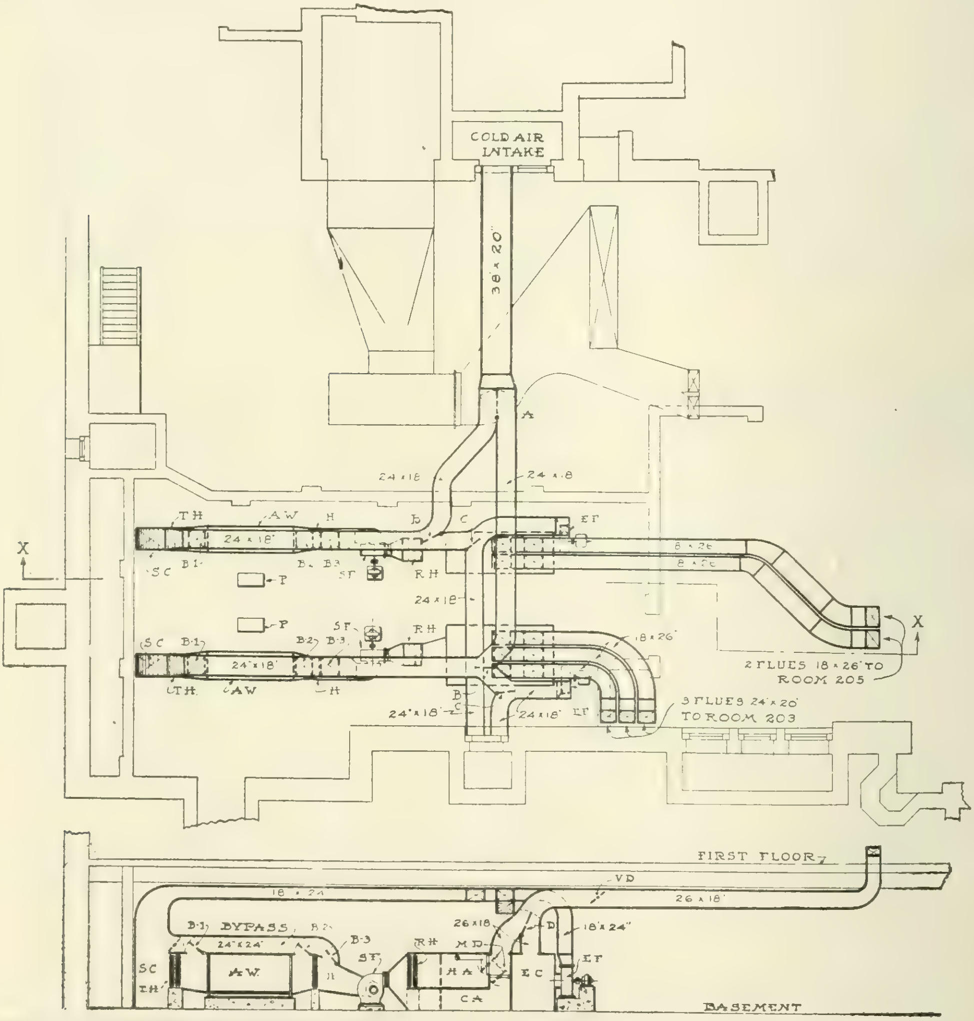

FIG. 10—ARRANGEMENT OF SEPARATE VENTILATING EQUIPMENTS FOR THE TWO EXPERIMENTAL ROOMS.

plenum chamber and a humidostat in the exhaust chamber, EC, controls the 2-in. diaphragm mixing valve on the hot water heater through which the air washer water is circulated.

When fresh outside air is used alone it enters through the main duct from the cold air intake and is deflected by by damper "A" to either apparatus as desired; it then passes across the top of the apparatus on the ceiling and drops down into the suction chamber, SC, in front of the tempering heater, TH. From this point to the supply fan it may pass either through the tempering heater, air washer and heater or it may be shunted across above these through a 24 in. × 24 in. bypass so as to bypass either the tempering heater, the air washer, the heater or all three by the use of bypass openings B1, B2, or B3. After entering the fan it is discharged through the heater into the hot air chamber, HA or through the bypass below the heater into the cold chamber, CA, according to the amounts of air allowed to pass out of

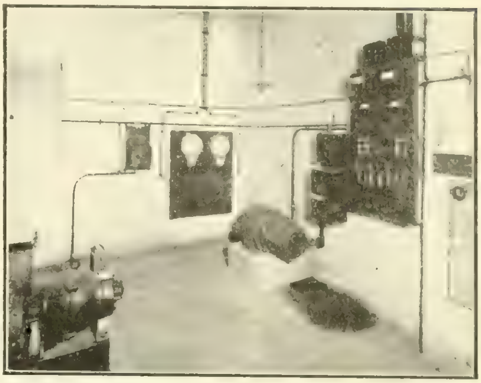

FIG. 11—TEMPERATURE CONTROL AND OTHER EQUIPMENT FOR EXPERIMENTAL APPARATUS.

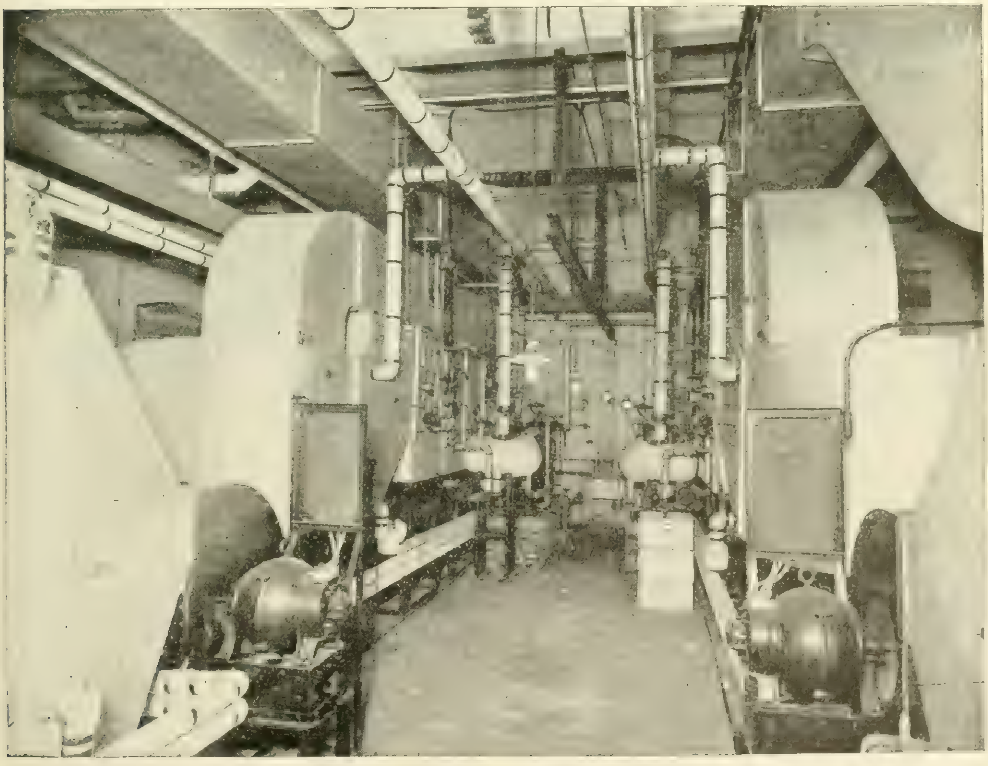

FIG. 12—VIEW OF APPARATUS ROOM, SHOWING AIR WASHER, PUMP, HOT WATER HEATER FOR AIR HUMIDIFYING AND SUPPLY FAN.

each chamber by the position of the mixing dampers, MD.

From this point it enters the 26 in. × 18 in. supply ducts which lead to the room. These ducts are connected with a branch both to the mixing dampers and to the exhaust chamber, ES, so that air may either be supplied by the supply fan (making the duct a supply line) or may be exhausted into the exhaust chamber (making the line an exhaust line) by simply shifting damper D. The exhaust fan, EF, sucks the air out of the exhaust chamber, EC, and discharges it either to the outside air through the exhaust outlet or into the cold air intake which carries it back to the inlet side of the apparatus for re-circulation, this being determined by the position of dampers B and C.

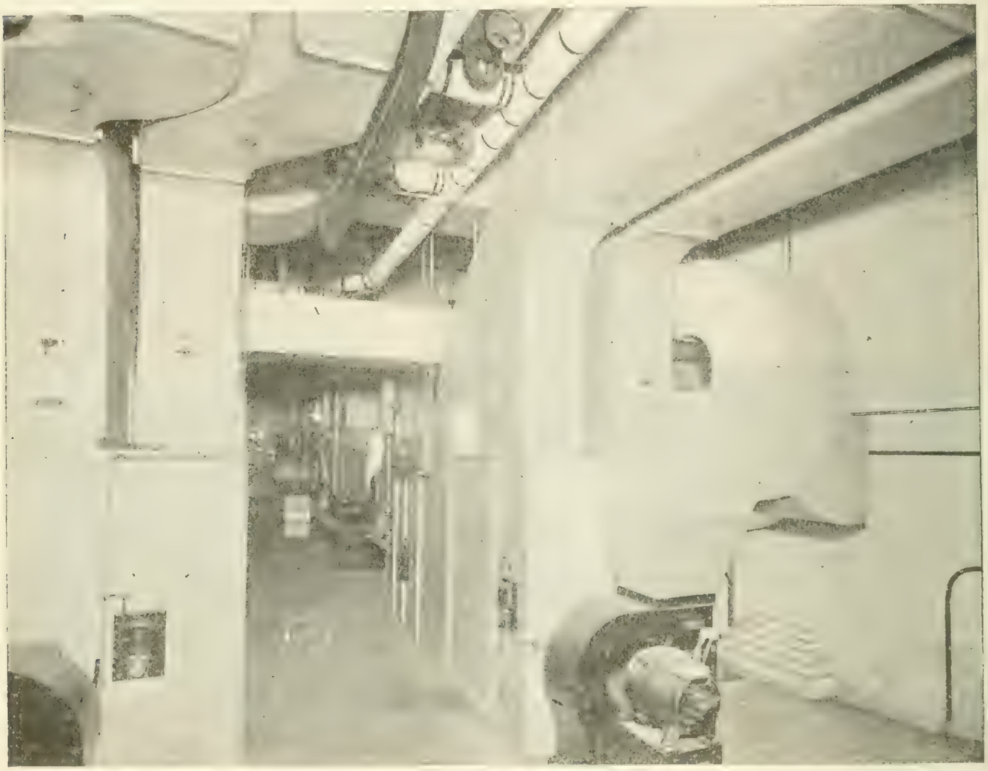

FIG. 13—VIEW FARTHER FRONT IN APPARATUS ROOM SHOWING EXHAUST FANS, PLENUM CHAMBER, DUCT WORK AND PRESSURE REDUCING VALVE.

The automatic control is operated by compressed air supplied Johnson air compressor, and current for the operation of the entire apparatus is furnished by a General Electric motor generator which transforms the two phase, alternating current into 220-volt direct current; the thermometer temperatures are recorded on Bristol recording thermometers, and the electric consumption is registered on electric meters made by the Sangamo Electric Co., Springfield, Ill., the arrangement of the equipment being shown in Fig. 11. Views of the apparatus room are shown in Figs. 12 and 13, Fig. 12 bringing out the air washer, air washer pump, P, hot water heater for air humidifying and supply fan; Fig. 13 is a view farther front showing the exhaust fans, plenum chambers, ducts and pressure reducing valve.

The reports based on the tests made with this apparatus are now being compiled by the commission.

Quantitative Determination of Air Dust

A Review of the Difficulties Encountered and the Development of a New Type of Dust Counter

By E. VERNON HILL, M.D.

Chief of the Division of Ventilation, Department of Health, Chicago, Ill.

Exact information as to the amount and character of the dust in a given quantity of air is often extremely important. It can also be truthfully stated that to obtain this information is often extremely difficult, even impossible. A little thought regarding the character of of air dust shows why this is so.

Dust is solid matter in a state of fine sub-division, the size of the particles depending upon the character of the dust, its source, etc. The individual particles range in magnitude from those plainly discernible to the naked eye and large enough to be easily and accurately weighed and measured, down to particles so small that the highest magnification fails to reveal their presence, and we might say still smaller, almost to the ultimate molecule.

It is not difficult to devise methods for collecting and weighing or counting the large particles, but when we consider that dust particles as a whole occur in uniform gradations, from the largest to those almost infinitely small, we see at once that it is practically impossible to devise or design any instrument that will retain and account for all of them. Any statement, therefore, regarding the weight of dust in a given quantity of air or the number of particles determined by counting by any of the various methods, must be considered as a *relative* determination, the degree of relativity depending upon the method used. This, however, need not necessarily disconcert us, absolue determinations not being essential to exact work. It is only necessary to establish a standard method which is relatively correct and approaches exactness in so far as this is practically possible.

METHODS TRIED BY CHICAGO DIVISION OF VENTILATION.

The experiments conducted, the many failures recorded, and the final accomplishment of our aims with regard to dust determinations in the Ventilation Division of the Chicago Health Department may be of interest to those who are following similar lines of experimentation.

The methods we have tried may be divided, for the sake of convenience, into five classes, viz.:

1. Visual comparison.
2. Weighing methods.
3. Condensation methods.
4. Diffraction methods.
5. Counting methods.

1. VISUAL COMPARISON:

Under this classification the first experiments were conducted with:

(*a*) *Cheese-Cloth Screens:* This was the only method known at the time we instituted work of this character for testing the efficiency of air washers. We used cheese-cloth screens stretched on a square frame having an area of 1 sq. ft. The screens were exposed for a given length of time at the proximal and distal ends of the washer and the degree of blackening or discoloration roughly approximated as a percentage ratio. This method was only applicable to determinations in air washers or in ducts where a relatively high velocity was present and was at best only a crude approximation of the quantity of dust present.

(*b*) *Porcelain Dish:* Fig. 1 shows two porcelain evaporating dishes with which some rough experiments were conducted. No. 1 is a clean dish free from dust.

No. 2 is its counterpart which was coated with clean, white vaseline and exposed in the open air for a certain length of time. The comparisons are much the same as with the cheese cloth screen method.

2. WEIGHING METHODS:

(*a*) *Filter Bags:* Fig. 2 shows the next device used. It consisted of a small Sirocco fan to the inlet of which was connected a metal funnel fitted with rings for holding fine mesh muslin bags, which were suspended in the funnel. The outlet of the fan was also provided with a metal cone of gradual slope in which an anemometer was placed to determine the amount of air passing through the instrument. A small tin receptacle is shown in the illustration for carrying the filter bags and protecting them from dust while not in use.

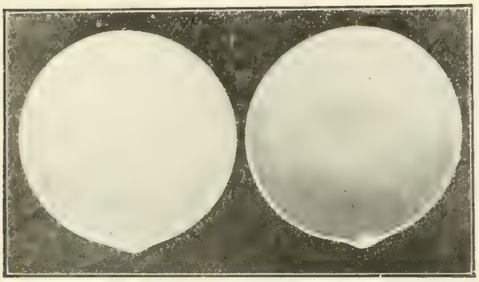

FIG. 1—PORCELAIN EVAPORATION DISHES FOR MAKING VISUAL DUST COMPARISONS.

The method was to dry and weigh each bag carefully, then place it in the cone inlet and pass from 100 to 500 cu. ft. of air through the same, then to again dry and carefully weigh, the increase in weight denoting the amount of dust in the quantity of air handled.

Quite a number of experiments were made with this device. One that is interesting should be mentioned. The instrument was placed in the intake of one of the ventilating units in the Chicago City Hall and a determination made of the quantity of dust entering. The instrument was then placed at the distal end of the air washer. As there was no space at the air washer outlet it was necessary to locate the instrument on the other side of the reheating coils; that is, the air passed through the air washer, then through the coils before reaching the instrument. We were surprised to find after completing this test that instead of a decrease the weight of the dust, after passing through the air washer and coils, had increased about 20%. The test was repeated with like results.

After some study of the results the writer concluded that the increased weight of the dust after passing through the coils must be due to particles of iron liberated from the coils and carried into the filter. The chemical test of the dust in the filter verified this conclusion. The fact that in cases of this kind our results were so misleading, the general cumbersomeness of the apparatus, the long time required in making a test, and the practical impossibility of making two tests at the same time, and also the fact that much of the finer dust passed through the filter, led us to discard this instrument as being impracticable and unreliable.

(*b*) *Cotton Filters:* Fig. 3 shows the next device employed. This consisted of a gas testing meter, the outlet of which was connected to a high-speed centrifugal fan mounted on a suitable resistance box with the necessary fuses,

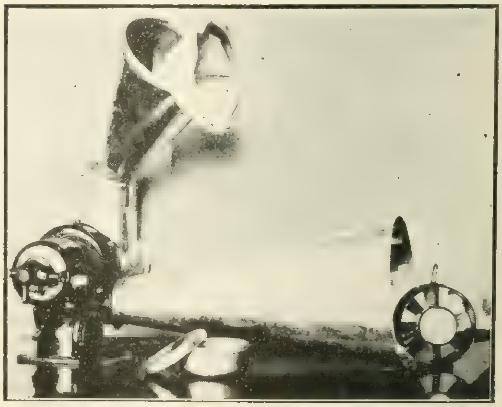

FIG. 2—FILTER BAG DEVICE.

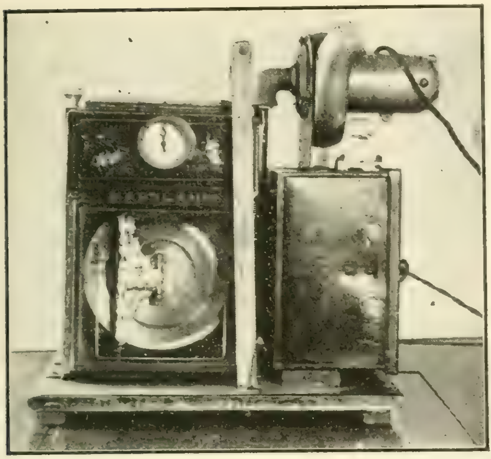

FIG. 3—COTTON FILTER METHOD.

switches, etc. The inlet of the meter was equipped with a glass receptacle, shown diagrametrically in Fig. 4 and so constructed that it could be used with either cotton, sand or sugar as filtering material. In this method the cotton was carefully dried and weighed, as with the filter bag method.

The superiority of this method over the one just described was that the gas meter made it possible to more accurately measure the quantity of air handled. The objections were the same as those noted in the filter bag method; also difficulty in weighing accurately the minute quantities of dust collected in comparatively clean air, even though 1,000 cu. ft. or more was passed through the instrument, and the fact that the weight changed, due to absorption, during the process of weighing. These elements of error made it apparent that this method was impractical and could not be relied upon.

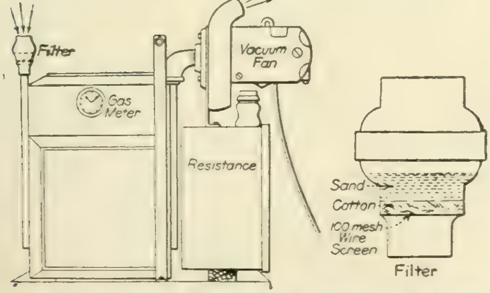

FIG. 4—DIAGRAM OF COTTON FILTER METHOD SHOWING GLASS RECEPTACLE AT INLET TO GAS METER.

(*c*) *Drechsel Wash Bottles:* This is a common method of collecting dust, gases, etc. by bubbling them through water. Considerable experimental work in testing air washers was carried out by this method. Figs. 5 and 6 show the method of using the wash bottles. A battery of six were installed both at the proximal and distal ends of the washer, the outlet from each set of bottles being connected to a common air pipe and these to the inlets of the gas meters. The outlets of the meters were connected to an exhaust tank provided with a vacuum gauge and automatic relief valve, to prevent excessive pressure.

FIG. 5—DRECHSEL WASH BOTTLES.

FIG. 6—DRECHSEL WASH BOTTLES.

In collecting dust by this method it was necessary to run a test for several days in order to get a sufficient amount of dust in the bottles at the distal end of the washer to make an accurate determination. After passing say 50 to 100 cu. ft. through the apparatus the bottles from each end were emptied into separate evaporating dishes, the water evaporated and the residue weighed. This method is fairly accurate with one exception, to be noted, but it is applicable only to work of this kind and requires a large amount of apparatus and considerable time. The inaccuracy is due to the fact that all dust is *not* retained in the bottle when bubbled through even at a slow velocity, as the finer particles in the interior of the air bubbles are carried through. This subject will be referred to later.

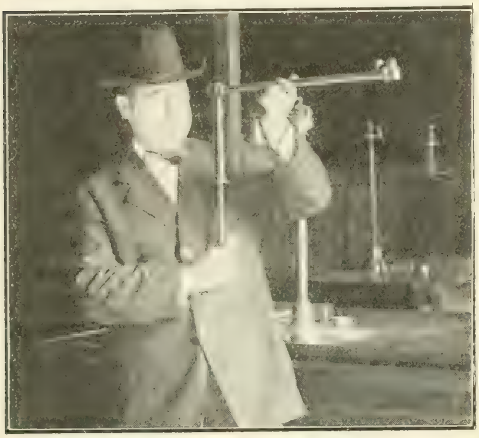

FIG. 7—KONISCOPE, DEVISED BY PROFESSOR JOHN AITKEN.

3. CONDENSATION METHODS:

(*a*) *Koniscope:* This instrument, shown in Fig. 7 is the early instrument devised by Professor John Aitken. The long horizontal tube is lined with hygroscopic material. It is provided with a window at each end and a stop cock at the distal end for admitting the air. The vertical portion of the instrument is a suction pump connected directly with the interior of the horizontal tube. Air for testing is drawn into the apparatus through the stop cock by depressing the plunger of the pump. The stop cock is then closed and the pump piston again depressed. This action rarifies the air in the tube which has become saturated by contact with the wet lining. Lowering the pressure in this manner has the same effect as lowering the temperature, the result being that the dew point is lowered and a fog produced by aqueous condensation on each dust particle, the density of which by comparison with suitable charts determining the extent of air dustiness.

Owing to the personal element involved in the use of this apparatus its value is questionable except when always used by the same person, and even then the results are not always consistent.

(*b*) *Aitken Dust Counter:* This is the next instrument designed by Professor Aitken in an endeavor to correct the defects in the Koniscope. It is shown in Figs. 9 and 10. In this instrument the same principle is made use of, but the condensed moisture is precipitated on an observing plate rather than viewed as a fog, as in the Koniscope previously described, and instead of observing the density or color of this fog the precipitated dust particles are actually counted.

The machine consists of a precipitation chamber with pump, eye piece, filter, etc., mounted on a tripod in a convenient and portable manner. For a complete description of this instrument the reader is referred to the 1914 report of The Chicago Commission on Ventilation.

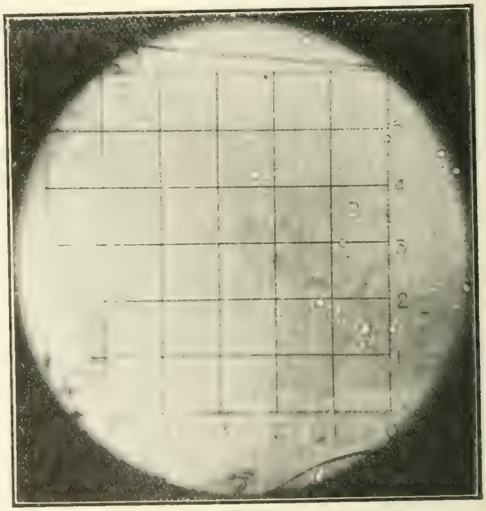

FIG. 8—MICROPHOTOGRAPH OF DUST TAKEN IN AITKEN DUST COUNTER.

This instrument was used by the Chicago Health Department for a considerable period and for some time reliance was placed on the results obtained. Frequently we found, however, that the results were not consistent and where we might reasonably expect to obtain a very low dust count we obtained the opposite, a very high one, although in these instances the particles of precipitated moisture were extremely small. It developed, on further study, that the instrument was accurate, in fact it was extremely so and the precipitation of large numbers of minute droplets proved to be dust particles so fine that they could not be discerned with the high power of the microscope and were, consequently, outside the range of those particles which we wished to detect and count. For this reason the instrument is impractical for the work intended.

4. DIFFRACTION METHODS:

(*a*) *Diffractoscope:* During the course of these experiments the writer conceived the idea of using a modification of the Aitken machine in which the presence of dust might be detected by means of the diffraction of rays of light by the minute droplets of water in the fog produced by lowering the dew point. The instrument * is shown in Figs. 11 and 12. It consists of a metal chamber 2½ in. in diameter and 6 in. long, lined with hygroscopic material and provided with windows at either end and on one side. A filter with a three-way cock, which allows air to be drawn through the same or directly from the outside, is attached to one end of the instrument and a hose cock connection for exhausting the air at the other. The method of using the instrument is as follows:

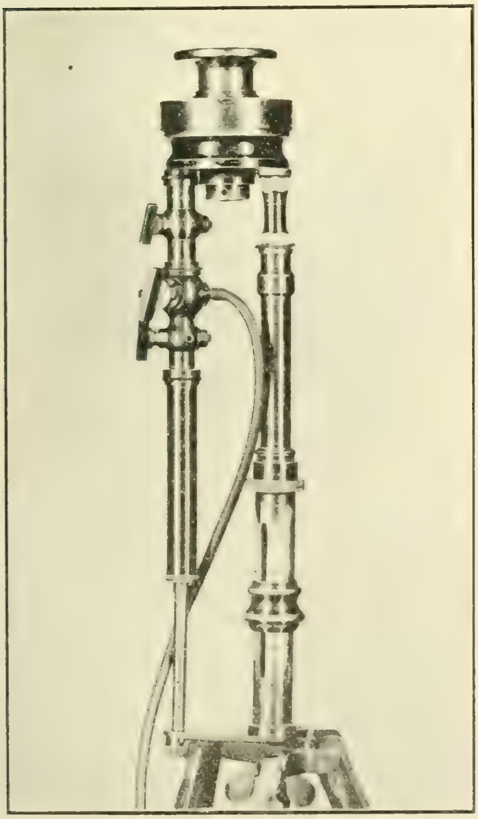

FIG. 9—AITKEN DUST COUNTER.

FIG. 10—AITKEN DUST COUNTER IN USE.

The hygroscopic lining of the chamber is saturated with water, the three-way cock is then turned so that air is introduced through the filter by operating the pump at the exhaust outlet and the chamber thus filled with clean, filtered air. A beam of light is now thrown into the side window from a strong arc. If the air in the instrument is free from dust a reduction of the pressure will not produce a fog and consequently the light beam will not be visible. If dust is present in the instrument a fog will result and the light beam stand out clearly. It developed, however, in experimenting with this device that air from the distal end of the washer, or air passed through a Drechsel wash bottle at a very low velocity still gave a positive result with the diffraction method. In other words, washing the air does not remove a sufficient amount of dust to prevent the formation of a fog when the pressure is reduced. If, however, the air is drawn into the instrument and allowed to stand for several hours, or a sufficient length of time for all of the dust to settle on the walls and bottom of the chamber, a reduction in pressure *does not* produce a fog, proving conclusively that dust must be present in order for a light beam to become visible. The instrument, therefore, is extremely accurate but too delicate for ordinary test work.

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* Furnished through the courtesy of William G. Braemer, then manager of the air conditioning department of Warren, Webster & Co.

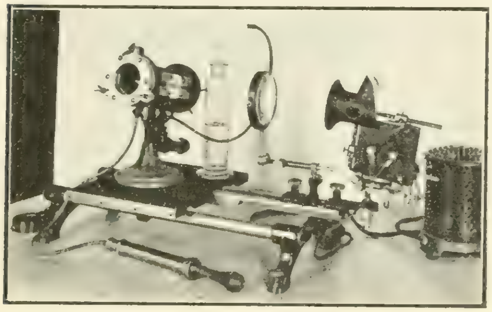

FIG. 11—DIFFRACTOSCOPE FOR DETECTING DUST BY DIFFRACTION OF LIGHT THROUGH MINUTE DROPLETS OF WATER PRODUCED BY LOWERING DEW POINT.

It has been of considerable value to us in the study of this subject and is evidently a reliable method of determining when a given sample of air is absolutely free from dust. Its use proves and illustrates the fact that air ordinarily considered dust free contains an enormous number of extremely fine particles that are not revealed by ordinary methods.

5. COUNTING METHODS:

(*a*) *Sugar Filter:* Fig. 4 showing the gas meter equipped for determining the amount of dust by collecting on a cotton filter and weighing, could also be adapted to dust counting by using sugar in the receptacle instead of cotton, filtering the air through this medium, dissolving the sugar in distilled water and making a count with the Sedgwick-Rafter counting cell. It is necessary to make control counts of the sugar when this method was used.

We found during these experiments that Crystal Domino sugar, put up in cartons, was practically free from dust. This method is fairly satisfactory, but certain elements of error exist which it is difficult to overcome. When the sugar is dissolved in the distilled water and a small portion taken for the count the receptacle containing the solution is first shaken to be sure that the particles contained do not settle to the bottom and to evenly distribute them throughout the liquid. This process breaks up some of

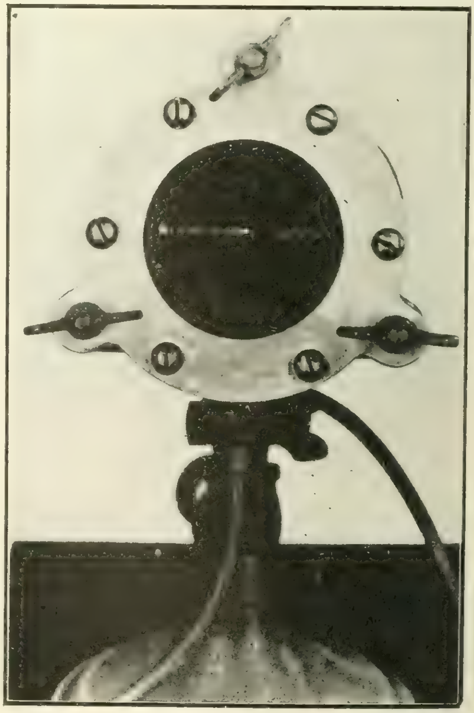

FIG. 12—LOOKING THROUGH THE DIFFRACTOSCOPE.

the large dust particles into numerous smaller ones and the resulting count is, therefore, considerably higher than it should be. The fact that a small portion only of the liquid is used is also an element of error that cannot be overcome.

The process of counting with the Sedgwick-Rafter cell is difficult, tedious and liable to error owing to the fact that the depth of the cell makes it necessary to re-focus and count at various depths through the specimen. With this method we not infrequently obtain results varying from 50% to 75% where we had reason to expect uniformity.

(*b*) *Drechsel Wash Bottles:* Instead of evaporating and weighing the residue in the wash bottle method we sometimes take specimens of the water in the bottle and make a count with the Sedgwick-Rafter cell. The count under these conditions was not as uniform or consistent as with the weighing method, due to the difficulties just enumerated.

(*c*) *Photographic Dust Count:* In the summer of 1916 the author noted, in developing micro-photographic plates, that the smallest particles of dust on the negative became fixed on the film during development and cracked off when drying, producing a clear spot on the glass. It occurred to me that this method might be used in developing a simple dust counting instrument and the one shown in Fig. 13 was the result. This consisted of a metal frame carrying an anemometer at the end where the air passed into the instrument, an exhaust ventilator at the other end to facilitate air motion through the same, and a compartment part way between, carrying a small 2¼×3¼ in. plate-holder so arranged that the entering air was thrown directly against the center of the plate. In using the instrument the plate holder is opened and clean distilled water applied to the central portion of the plate with a clean camel's hair brush. The water softens the film on the plate which retains the dust particles that are forced against it. After exposing it in a current of air where a dust determination is to be made, or swinging it if there was no air motion, the plate is dried and developed in the ordinary manner. The count of the particles is made with the aid of low magnification or prints made from the negative as in ordinary photographic work. This instrument is very simple and easy to use and if extreme accuracy is not desired gives very fair and consistent results.

The principal objection to the instrument is that dust particles will lodge on the anemometer and various parts of the interior of the instrument in front of the photographic plate, and unless carefully cleaned before every test are a serious source of error. The thorough cleaning of the instrument is tedious and difficult and its utility is, therefore, diminished to that extent.

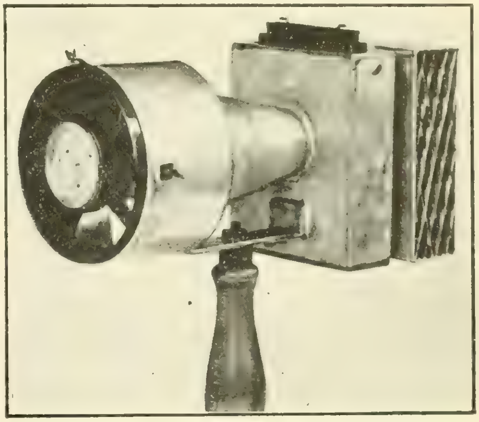

FIG. 13—PHOTOGRAPHIC DUST COUNTER.

The next and the last device is the dust counter shown in Fig. 14. This consists essentially of an exhaust pump of known capacity for handling the air and a small capsule or shell affixed to the inlet of the pump carrying a cover glass, coated with adhesive material for catching and retaining the dust.

The first design of this instrument is shown in Fig. 14. The writer's first experiments in this line were made by drawing a quantity of air into a syringe and forcing it out against a slide covered with adhesive material and counting the number of particles with a microscope. In using this method we found a serious source of error in the retention of dust particles in the barrel of the pump. A device was, therefore, arranged to carry the cover slip on the interior of the pump directly beneath the intake nozzle. With this arrangement the dust was projected against the adhesive material before coming in contact with the interior of the pump.

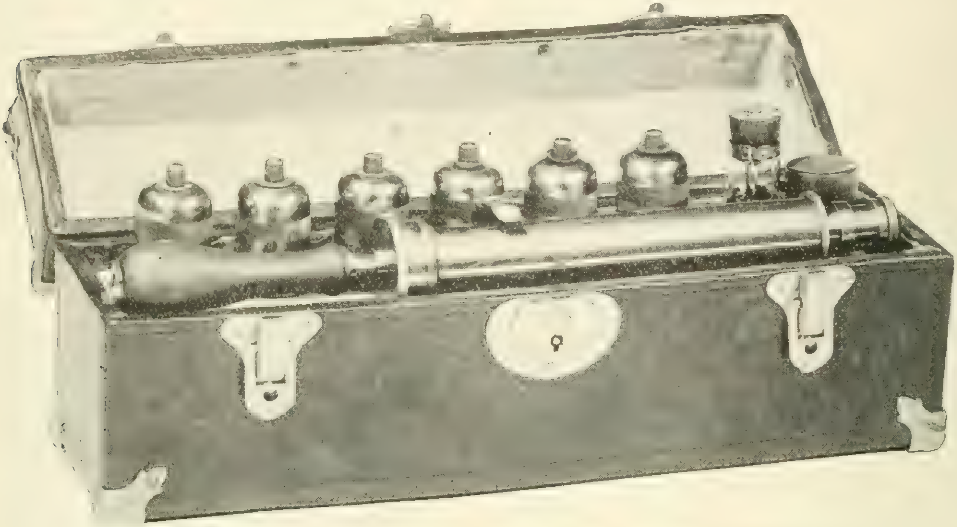

FIG. 14—NEW TYPE OF DUST COUNTER DESIGNED BY DOCTOR E. VERNON HILL.

This was the first instrument developed in the long series of tests with which a consistent and practical determination could be made. In developing the idea just described the next step was to find some means of calibrating the instrument. It was evident that all of the dust projected against the adhesive plate was not retained, some must of necessity escape. We, therefore, constructed a number of capsules as a separate part of the instrument and designed them in such a way that one could be superimposed upon the other and the air sample drawn through them in series (See Fig. 15). By experiment we found that with six such capsules under ordinary or moderately extreme conditions of air dustiness no dust was found in the last capsule, Counts were then made of the samples in the consecutive capsules and a percentage determination arrived at for the amount retained by the first capsule. In routine tests with the instrument, therefore, it is only necessary to use one capsule and correct the result by the factor given for the nature of the work in hand. This for ordinary tests is 62%.

Fig. 16 is a detailed drawing of the instrument and Fig. 17 is a photograph of a dust sample taken. This machine has been in use in the Chicago

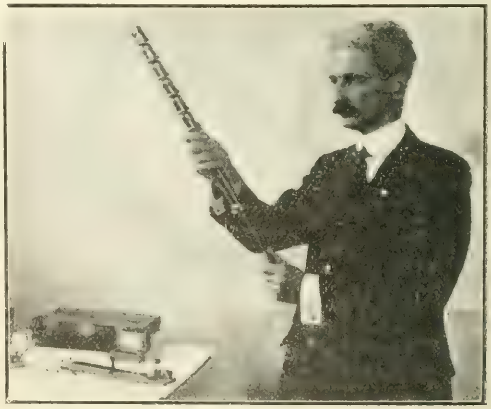

FIG. 15—HILL DUST COUNTER WITH SUPERIMPOSED CAPSULES FOR CALIBRATING THE INSTRUMENT.

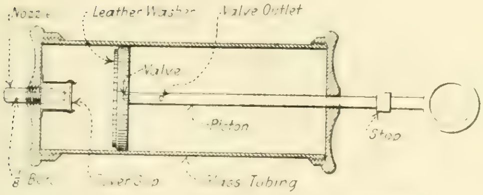

FIG. 16—DETAIL OF HILL DUST COUNTER.

Health Department and by the Chicago Commission on Ventilation during the past winter with very satisfactory results.

METHOD OF USING NEW DUST COUNTER.

In using the instrument the cover of the capsule is removed from the base and a clean ⅜ in. microscopic cover glass inserted in the holder that is provided. The cover glass is then smeared lightly with a mixture of Damar varnish, glycerine and linseed oil of such a consistency that it will not dry or form a surface film when the instrument is in use but will become firm within twenty-four hours. The cover is replaced on the base of the capsule which is then screwed on to the nozzle of the pump. A certain number of strokes with the pump is now taken in the air where the determination is to be made, the number of strokes varying with the extent of dustiness expected. Care in this regard must be taken, an excessive amount of dust on the slide makes it difficult to count. In an ordinary office or school room about 5 to 10 strokes are all that are required. Outdoors, where the air is reasonably clear, 15 or 20 strokes are necessary. After the necessary number of strokes has been taken the capsule is removed from the base. The base is held inverted during this operation so that no dust particles in the air will settle on the specimen. The cover slip is removed from the holder in the inverted position and placed on a clean microscopic slide with the adhesive side against the slide and the specimen placed on the stage of the microscope and a count made. The microscope should be equipped with a No. 3 objective and a No. 1 eye piece, in which is placed the ruled ocular, supplied with the instrument.

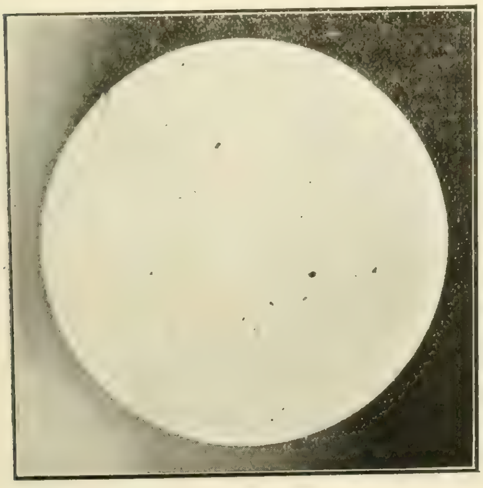

FIG. 17—DUST SAMPLE TAKEN ON STREET CAR BY HILL DUST COUNTER.

As the capacity of the pump is 4 cu. in., each stroke represents 4/1728 of a cubic foot. The operation of counting is simplified without material loss in accuracy by counting only those particles within the limits of the square of the ocular. This, however, necessitates the further correction of 80.8% of the total number of dust particles retained on the cover glass. This gives us a correction factor of 50.096% as the total amount of dust that is retained on the cover glass. The formula, therefore, is as follows:

$$D = \frac{480^{*} \times 2 \times c}{N}$$

when D = dust particles per cubic foot.
C = count in one square.
N = number of pump strokes.

During the past winter we have made several hundred tests with this instrument and have found the results, without exception, consistent and satisfacory. With very simple instructions any ordinarily intelligent person can collect samples and make the count in a satisfactory manner. Not only is it possible with the instrument to accurately determine the number of dust particles, but a study of the *kind and character* of the dust under observation is often instructive and valuable. This feature greatly enhances the value of the method and makes the work extremely interesting. Counted by this method the particles in clean, outdoor air average from 500 to 1,500 per cubic foot. In a mechanically-ventilated school room, without air washers or other air cleaning device, from 10,000 to 30,000. It is also a practical method for testing the efficiency of air washers. For this purpose a "Y" connection is used on the pump and two capsules used simultaneously, one at the proximal and one at the distal end of the washer, connections being made to the pump with rubber tubing.

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* Capacity of pump 1/432 becomes 1/480 on test, owing to pump leakage and space occupied by plunger rod.

NEW TESTS OF DUST REMOVAL BY AIR WASHER.

Some experimental results obtained by two students of the Armour Institute of Technology in work of this kind are of interest. Mr. Otto Armspach and Mr. E. W. Haines made these tests in preparing their graduation theses for their degrees. The tests were conducted during March and April of the present year on a Webster air washer * (shown in Fig. 18) in the experimental laboratory of the Ventilation Division of the Chicago Health Department. Aside from a large number of tests of various kinds which they will shortly publish in their theses the following is of interest:

QUANTITATIVE DETERMINATIONS OF VARIOUS KINDS OF DUST REMOVED BY AN AIR WASHER.

	Medium.	*Heavy.*
Lamp Black	89.4	91.2
Rubber dust	90	92.3
Street dust	96.2	98.2
Wood dust	96.5	99.2
Grain dust	98.5	99.2
Rattler dust	99.5	99.7

The "Medium" and "Heavy" at the head of the two columns refers to the amount of dust that was liberated in vicinity of the intake of the washer. These are the only tests of this character that the writer knows of in the literature of air conditioning work.

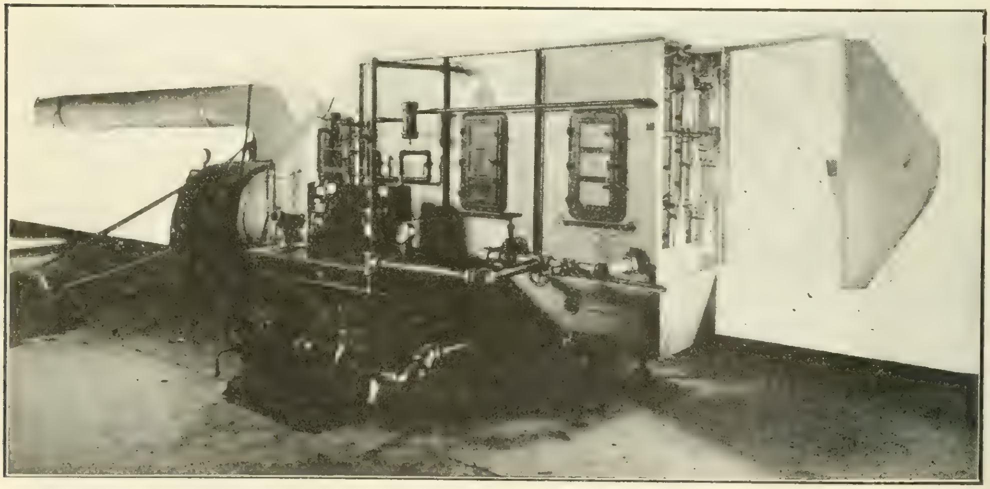

FIG. 18—EXPERIMENTAL EQUIPMENT USED BY CHICAGO VENTILATION COMMISSION, CONSISTING OF AIR WASHER ARRANGED FOR TESTING BY VARIOUS METHODS.

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* Furnished through the courtesy of William G. Braemer, then manager of the air conditioning department of Warren, Webster & Co.

A statement previously advanced by the writer is brought out clearly in these tests, viz.: that the per cent of efficiency in dust removal of an air washer increases directly with the amount of dust entering the washer. In every instance these tests show the per cent of removal higher when the quantity is "heavy."

In conclusion, the writer would emphasize the statement made at the beginning of this paper, viz.: that with any method of dust determination the results are relative only, they cannot be absolute. This is due to the fact that a considerable number of the minute dust particles that are always present are not caught in the liquid when dust is colleced by bubbling through water but pass through with the bubbles, the amount retained increasing as the size of the bubbles and velocity of air passing through the liquid decreases. We have repeatedly drawn room air through a Drechsel bottle with a 3-in. water seal and counted as high as 7,000 small particles per cubic foot that were not retained in the water. Air passed through four wash bottles in series still gives a light beam with the diffractoscope. On the other hand, while much of the dust that passes through the wash bottle can be collected and counted with this latest dust counter, even with this instrument some particles are so small that the magnification used does not reveal their presence.

Comparison of Pipe Coils and Cast-Iron Sections for Warming Air

By PROF. JOHN R. ALLEN.

(Abstract of paper read from manuscript at the recent annual meeting of The American Society of Heating Engineers and published in the society's Journal for April, 1917.)

Data for the desinging engineer as to the comparative effects of pipe coils or cast-iron sections as types of radiation, which will be useful in laying out a ventilating system, were presented, based on an entirely new set of experiments, as far as the results on pipe coils are concerned, made at the Research Laboratory of the American Radiator Company, in Buffalo, N. Y. The conclusions reached are:

1. The condensation in pounds per square foot per hour for both pipe coils and cast-iron surfaces depends, in properly-designed surfaces, upon the friction of the coil, and
2. The friction of pipe coils varies as the velocity to the 1.9 power and, in cast-iron sections, as the square.

APPARATUS USED.

The experiments on pipe coils were made with an American Blower Company No. 25-A pipe coil, with 1-in. pipes spaced 2¾-in. on centers, with pipes 5 ft. and 5 ft. 3 in. in height. Each section contained four staggered rows of pipe, making 192.55 sq. ft. per section, with a free air area as measured between the first row of pipes of 17.1 sq. ft.

The illustration of the pipe coils (Fig. 1) shows the covering used to protect the thermometers from radiant heat. It also shows the piping used to obtain the static pressure on the inlet side of the coil. An inclined platform 4 ft. long, was placed in front of the coils and a similar one after the coils to prevent the air currents ordinarily produced by the base of the coil.

Figs. 2 and 3 show the piping connections to the coils, the steam separator, manometer for measuring the resistance of the coil, the steam guage, and the

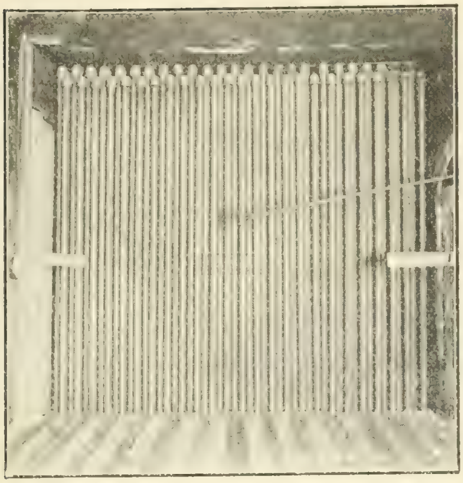

FIG. 1—HEATING COILS IN TESTING CHAMBER.

steam-jacketed tank for collecting condensation. The water level was maintained constant in this tank during the tests, as nearly as possible.

Fig. 4 shows the air-discharge piping connecting the coils with the fan, the location of the Pitot tube and slant gauge, and the board used to locate the Pitot tube positions at which the readings were taken. Forty readings of the manometer were taken for each test and averaged.

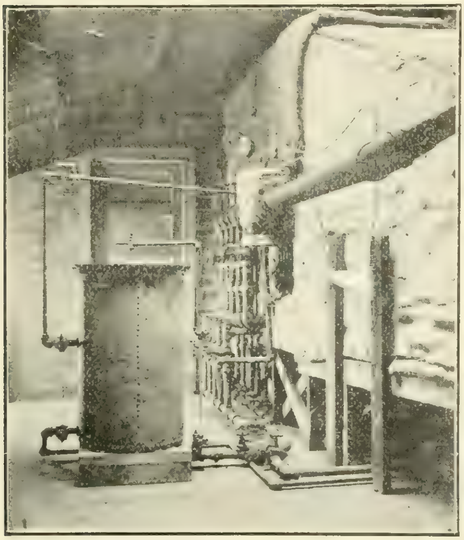

FIG. 2—PIPING CONNECTIONS TO COILS AND CONDENSATION TANK, AND MANOMETER.

Fig. 5 shows the weighing barrels located on the floor below in which the condensation from the coils was weighed. The condensation was collected in one barrel while the weight was being taken in the other barrel, so that the weighing could be done accurately, and the weights were checked at 15-min. intervals.

Before starting the tests, the coils were put under steam pressure and carefully examined to see that they were hot all over and not air bound at any point. The velocity of the air through the coils was adjusted by means of the speed of the fan and the adjustment of the dampers. The air velocities were measured by means of a Pitot tube and manometer. The velocity determined by the Pilot tube was checked with the velocity determined from the condensation of steam in the coils. In most of the tests these velocities checked within less than 1% and in all cases in less than 5%. In making the final computations the velocities as determined from condensation were used.

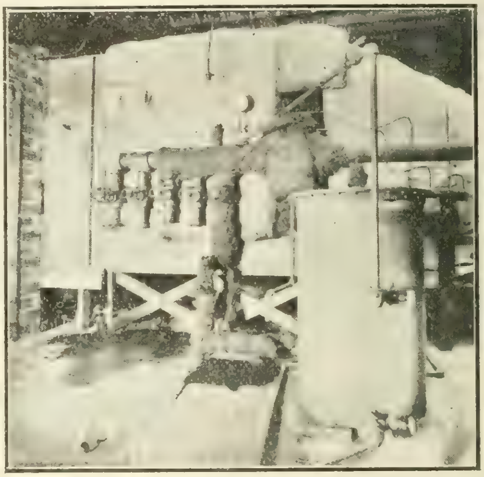

FIG. 3—STEAM-JACKETED CONDENSATION TANK, SEPARATOR AND STEAM GAUGE.

Table 1 shows the principal average results from the different tests. From the results of these tests Fig. 6 has been constructed.

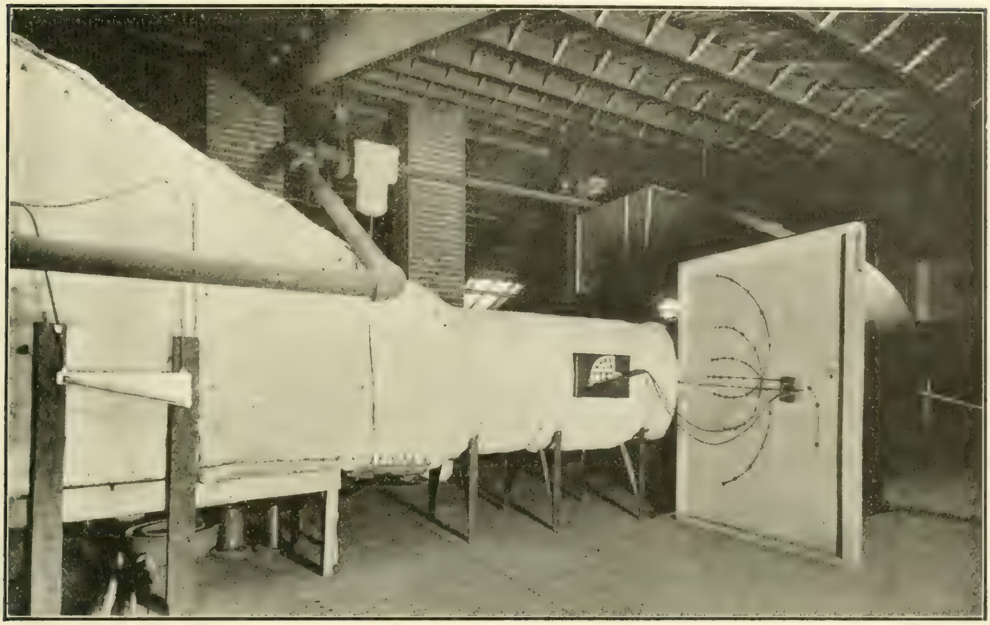

FIG. 4—AIR CONNECTION BETWEEN COILS AND FAN, PITOT TUBE, SLANT GUAGE AND LOCATION BOARD.

The velocities shown on this chart are for the new free area of the A.B.C. coil. These areas are taken on the diagonals between the two staggered rows and are two-thirds of the area taken between the pipes of the first row. The velocities on the chart are therefore 50% more than if the area is taken between the pipes of the first row, which is the usual custom. In fact, as this paper shows, it is not material where the free area is taken, as the effectiveness of the coil depends primarily upon the friction in this type of heater and not upon the velocity passing through the coil. This fact is pointed out as different manufacturers differ in their practice in regard to the measuring of free air area. If

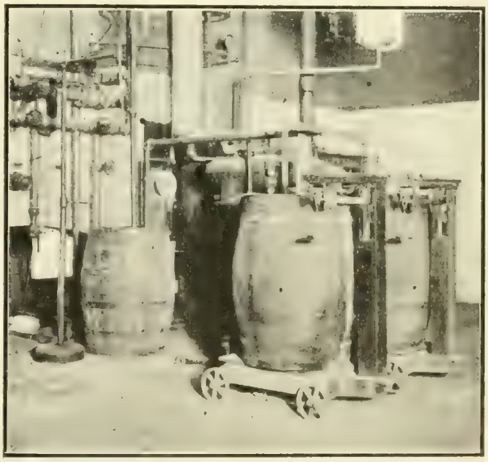

FIG. 5—WEIGHING BARRELS.

TABLE 1.—RESULTS OF TEST ON 1-IN. PIPE COILS, 2¾-IN. CENTERS.

Date of test—1916	Nov. 23	Nov. 24	Nov. 24	Nov. 24	Nov. 26	Nov. 26	Nov. 26	Nov. 28	Nov. 28	Nov. 28
Number of test	1	3	4	5	6	7	8	9	10	11
Number of stacks or sections deep	5	5	5	5	3	3	3	1	1	1
Friction, in. of water	.417	.120	.240	.540	.330	.220	.110	.108	.068	.030
Velocity of air, ft. per min. at 70° F.	1045	542	768	1196	1181	955	695	1189	947	655
Steam temp. in heater	223.25	226.90	225.75	222.44	225.60	226.25	226.70	227.60	226.00	227.16
Temp. entering air, deg. F.	58.94	49.44	43.56	38.80	32.94	36.06	39.50	46.69	46.63	49.50
Temp. leaving air, deg.	126.06	140.90	126.44	112.40	83.25	89.16	97.44	63.34	64.44	70.16
Temp. rise, deg. F.	67.12	91.46	82.88	73.60	50.31	53.10	57.94	16.65	17.81	20.66
Total condensation, lbs.	1342	949	1221.5	1685.3	1140.5	974.0	773.0	380.5	324.0	260.0
Condensation per sq. ft. per hour, lbs.	1.393	.986	1.270	1.750	1.974	1.685	1.338	1.975	1.683	1.350
Total heating surface, sq. ft.	962.75	962.75	962.75	962.75	577.65	577.65	577.65	192.55	192.55	192.55

Each stack—four rows deep by 25 pipes wide; free area, sq. ft.—17.1.

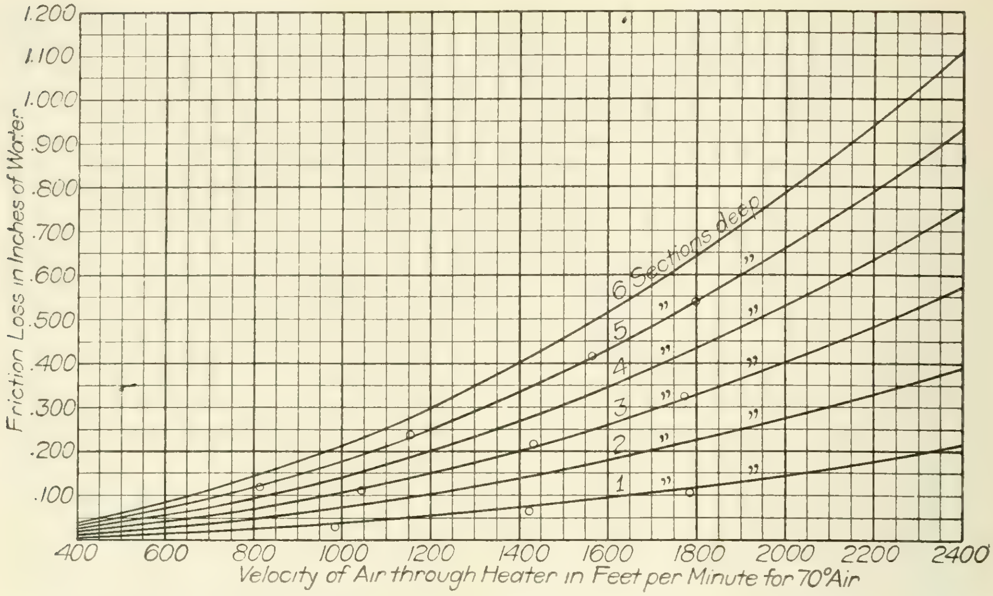

FIG. 6—FRICTION CHART FOR 1-IN. PIPE COILS BASED ON THEIR FREE AREAS.

two-thirds of the velocities shown in the tables are taken, instead of the velocities given, then the results shown on the charts will be for velocities where the free air area is taken as the area between the first row of pipes. This applies to all the pipe coil figures and tables except Fig. 7.

Fig. 7 shows the temperature of the air leaving the coil with the air entering at zero temperature. Velocities in this figure are for free air areas taken be-

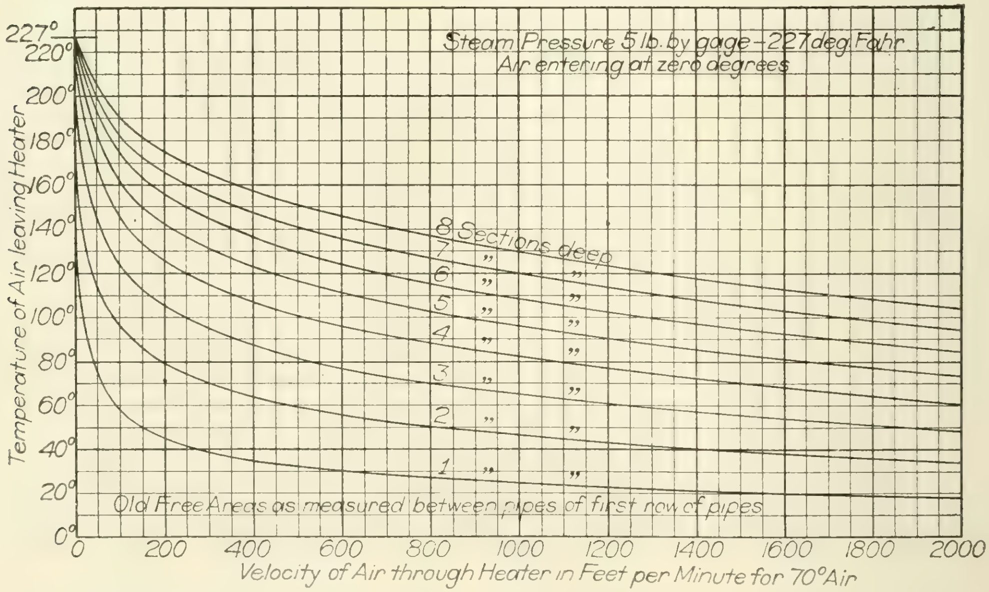

FIG. 7—TEMPERATURE CHART FOR 4-ROW PIPE COILS WITH 1-IN. PIPES SPACED ON 2¾-IN. CENTERS.

tween the first row of pipes and the figure gives the rise of temperature that would be obtained for different numbers of stacks at varying velocities through the coil.

(Tables were also presented showing the final temperatures and condensations for different velocities and numbers of stacks, with pipe coils carrying steam at 227° F. and different entering air temperatures.)

The velocities for the actual tests were computed from the condensation. The condensation was computed for intermediate points for different velocities by the following expression:

$$S \times N \times C \times L = V \times a\ (t - t_1) \times 0.24 \times 60 \times 0.07495 \ldots\ldots (1)$$

where S = square feet of heating surface per stack,
C = condensation per square foot per hour (L.B.S.),
L = latent heat = 970.7 B.T.U. for 227° F.,
V = velocity in feet per minute,
$t - t_1$ = rise in temperature,
a = free area in coil on the diagonal = 17.1 × 2/3,
N = number of stacks,
0.24 = specific heat of air,
0.07495 = weight of 1 cu. ft. of air at 70° F. and a barometer of 29.92 in.

The heating surface in one stack amounts to 192.55 sq. ft. Simplifying equation (1) and solving for C, the equation becomes:

$$C = \frac{1.079 \times 17.1 \times 2/3}{192.55 \times 960.7} \times \frac{V\ (t - t_1)}{N}$$

$$= \frac{V\ (t - t_1)}{15037 \times N} \ldots\ldots\ldots\ldots (2)$$

Assuming any velocity and range of temperature the corresponding condensation has been obtained for any number of stacks from the expression equation (2).

(The results, as given in the author's tables, check very closely, he states, with the results given by L. C. Soule in Vol. XIX of the Society's Transactions. For the convenience of the reader in making comparisons tables were also included for Vento cast-iron sections.)

Using the same notation as for the pipe coil, the expression for the condensation in the cast-iron section becomes

$$C = \frac{V\ (t - t_1)}{13130 \times N} \ldots\ldots\ldots\ldots (3)$$

By the use of logarithmic plotting paper it is possible to combine the results from tests on pipe coils with those on cast-iron sections in one chart and this chart can be used to obtain any quantity desired for both cast iron and pipe coil surfaces. Fig. 8 is a logarithmic chart showing results of these tests plotted on logarithmic paper for both pipe coil and Vento surfaces on the same sheet. This figure shows graphically many things that would not be easily observed from the tables. Fig. 8 is divided into two parts, the left-hand half of the figure showing the results for 1-in. pipe coils on 2¾ in. centers, as obtained from the tests just made. The right-hand half of the figure shows the same results for cast-iron surfaces. These Vento results were taken from the tests made by L. C. Soule and have been checked on these charts.

On the left-hand side of the chart the figures shown are for velocities passing through the coil. These velocities are also shown on the right-hand side of the chart. On the line dividing the two parts of the figure is given the condensation in pounds per square foot. This line can be used either for pipe coil or for cast-iron surface. The lower line gives the friction resistance in inches of water—on the left-hand side for pipe coils and on the right-hand side for the cast-iron radiation. The upper line shows the differences between the air entering and the air leaving the surfaces —on the left-hand side for the pipe coil and on the right-hand for the cast-iron radiation.

USE OF CHART

In order to explain the use of the chart, we will take an assumed case. With five stacks and an entering temperature of—30° F., leaving temperature for a 1200 ft. velocity is 89°, making the difference between entering and leaving air 119°. Now referring to the dotted lines on Fig. 8a, the horizontal line for 1200 ft. velocity intersects the vertical line representing 119° at the point A. From the point A, draw a line at 45° until it intersects the vertical line for five stacks. From this point of intersection, extend a horizontal line to the center line of the chart and we see that the condensation is 1.89 lbs. The resistance is obtained by extending the horizontal line for 1200 ft. velocity until it intersects the diagonal line for five stacks; a vertical line from this intersection shows that the resistance is 0.25 in. of water.

Let us assume a similar case for cast-

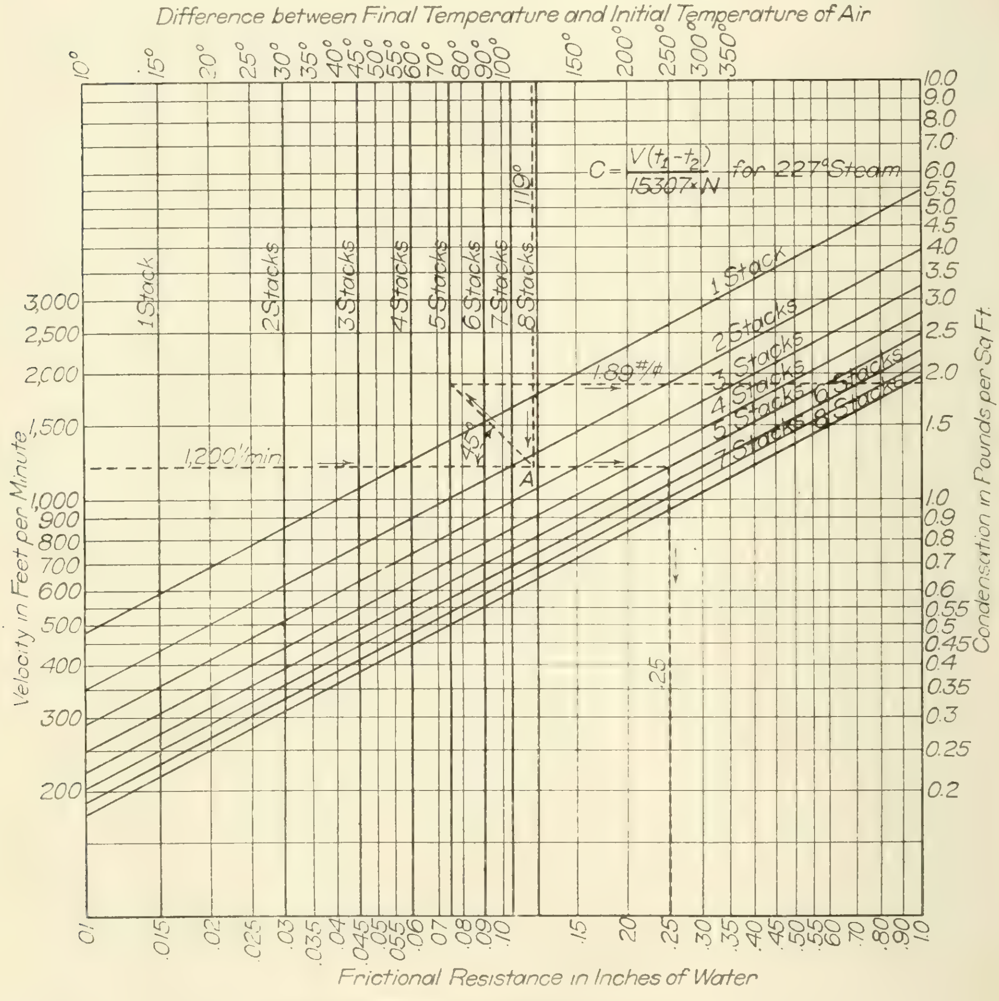

FIG. 8-A—RESULTS OF TESTS OF PIPE COILS.

iron radiation. Take the same resistance (0.25 in.) on the right-hand side of the chart and extend a vertical line until it intersects the diagonal line for five stacks. From this point carry a horizontal line until it intersects the line for increase of temperature of 120°. From this point carry a 45° line until it intersects the vertical line for five stacks. From this point of intersection extend the line to the center line of the chart and the condensation will be seen to be a little over 1.9 lbs. The horizontal line from the intersection of the 0.25 friction line and the diagonal for five stacks, carried to the right, shows that the corresponding velocity in the cast-iron surface is 1068 ft. per minute.

CONCLUSIONS

It will be noticed in comparing the examples for pipe coil and cast-iron surfaces that similar resistances give almost the same condensation. If the difference in temperature in both cases had been taken as 119°, the condensation would have been almost identically the same; it would vary in the two cases by less than 2%. Velocities are, however,

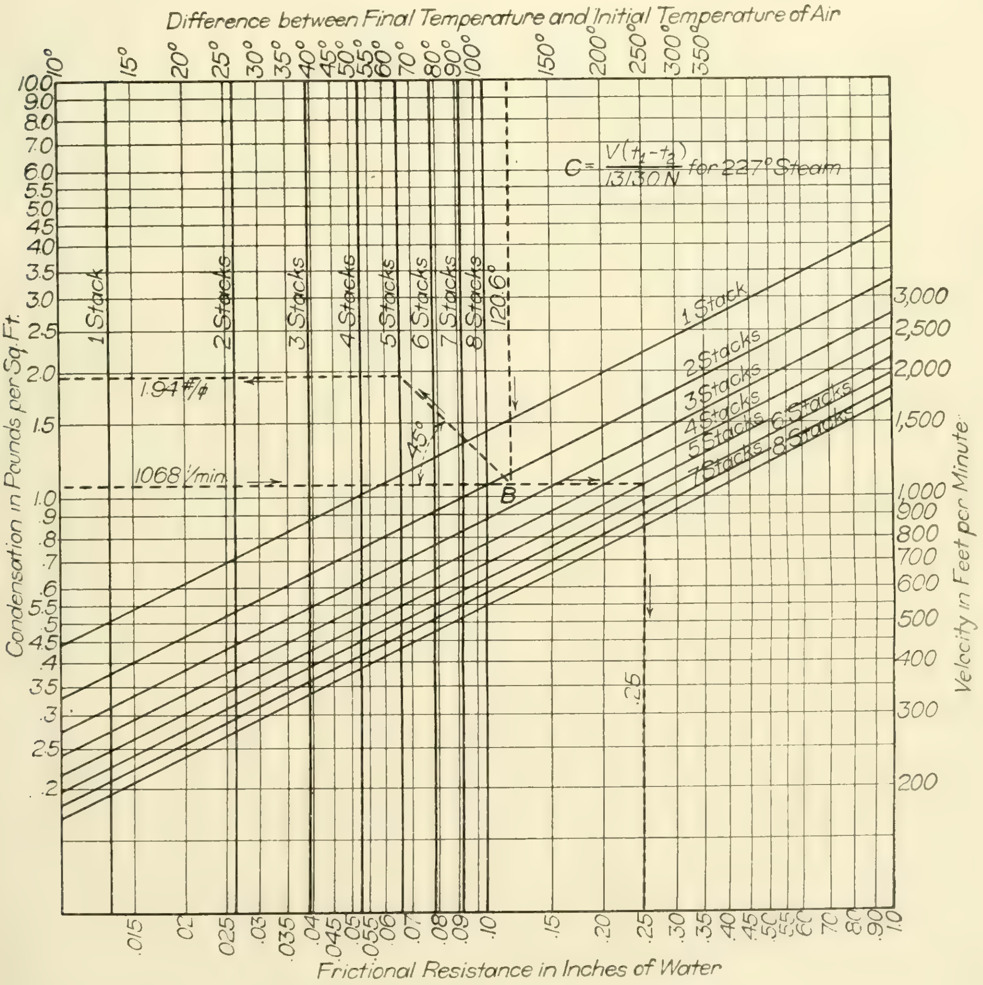

FIG. 8-B—RESULTS OF TESTS OF VENTO HEATERS.

quite different, the cast-iron surface having a velocity of 11% less than the pipe coil. If this same operation is repeated for a great many different conditions for both pipe coil and cast-iron surfaces, it will be found that in all cases equal frictions give almost identical condensations, while, as the friction varies as the 1.9 power of the velocity, the velocities will necessarily show considerable variation. The condensation of a coil is the measure of its heating effect and the efficiency of a coil is approximately 100%. This figure, therefore, shows, that the heating effect of a blast heater surface, properly designed, depends upon the friction of the coil and not upon the catalogue velocities, and that in properly-designed coils it is better to compare various coils by their friction losses than by velocities and free air areas.

For the designing engineer it would be better to assume friction in selecting a coil than to assume velocity. This being the case, it is immaterial where the free area of a coil is taken, as the friction depends upon the volume of air passing through the coil.

Fig. 8 also shows the relation between the velocity of the air and the friction.

It is, of course, possible to construct a poorly designed heater either in pipe coil or cast-iron sections in which condensation will not be proportional to friction. In one case, the areas in the coils might be so open that the air could pass through the coil without being materially heated. It is also possible to construct a coil in which the friction would be excessive, in which case there would be a loss of effectiveness due to excessive eddy currents. In any coils properly designed the condensation should be proportional to the friction through the heater and were it possible to construct a perfect design of coil, this relation would be absolutely true.

In the design of ventilating systems many engineers and architects have not given sufficient attention to the friction of air passing through the heater. The results of this paper would seem to show that the friction through the heater is the most important consideration in the selection of a heater. Good practice requires that the friction of the heater should not exceed more than one-half the total pressure produced by the fan. If the heater friction is too high, excess pressure must be produced by the fan to overcome this friction, requiring additional power to drive the fan. This additional power means an extra charge which is an operating expense and must be paid throughout the whole operating life of the plant. If the friction is taken too low, then the coil becomes ineffective and a much larger coil must be used than is necessary to produce the heating effect desired. The heating resistance of the heater should be proportioned to the piping resistance or to the total pressure produced by the fan. The exact proportion that should be used has, as far as the author knows, only been roughly approximated.

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Explosions in Enameling Ovens.

As a result of a number of serious explosions in enameling ovens, both gas and electric, throughout the country, the Ford Motor Company has carried on a series of experiments in an effort to find some reliable means of preventing such explosions.

These explosions usually occurred in the large pipes used for supplying air to the gas furnaces. It was found that these resulted from gas backing up into the air pipes, even though supposedly adequate check valves had been installed at the proper points.

The means taken to overcome the damage done by these explosions are described in *Safety Engineering*. Paper drums were placed over suitable heads at frequent intervals along the main pipe lines and these were found to provide sufficient outlet to prevent any serious consequences in case of explosion.

The success of this plan led to its trial on the ovens. Two holes, each 3 ft. square, were cut in the top of a large enameling oven and ¼-in. plates placed over the holes. The oven was then filled with gas and exploded with an electric spark. The plates were blown 30 ft. into the air, while the small latch holding the doors shut was broken and the doors hurled back with great force. The explosion proved that the holes in the top of the oven were not sufficiently large to take care of the explosion without damaging the oven.

REMEDY FOUND IN LOOSE TOP.

To correct that difficulty the top was loosened, but still allowed to rest in its usual position. The doors were strongly secured. Several explosions were made and the top lifted from 3 in. to 15 in., varying with the force of the explosion. The top weighed approximately 7 lbs. to the square foot. None of these explosions injured the oven, while the pressure on the doors was not heavy. With the top fastened down, however, and all other outlets stopped, the oven would have been wrecked.

These experiments were all carried out under the direction of the Ford factory superintendent and proved so satisfactory that he ordered all Ford enameling ovens changed so that, in case of explosions, the tops will lift and dissipate the force of the explosion without damage to the ovens.

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How to Build Houses To Retain Heat.

When a man builds a house in which he is likely to spend a half or more of his days, it is a matter of some little importance to him that it be built well—not merely that it be built so that it wll not fall down, but so that it will leak neither water nor weather. A leaky house is a misery and a misfortune. It is almost sure to be a permanent liability.

In building remember that no roofing is too good to cover your head. He who thinks to save money by using a cheap grade of shingles has much to learn at large cost. Shingles are not necessarily right because made of West Coast cedar, not because marked "Extra Star A Star." Before you buy shingles for your house, have the lumber merchant show you samples of all his stock. If he has a large variety, and something ultra good, order the best he has. A "thick clear" red cedar shingle on a not too flat roof will be found one of the most satisfactory roofings ever put on a dwelling.

DON'T EXPERIMENT WITH ROOF.

There are other good roofs, some of them better than shingles, perhaps, but if you don't know how good they are, insist on seeing the material and on interviewing men who have used them before trying an experiment with them yourself. A leak in a roof is one of the most prolific causes of a chronic profane temper in the householder. A leak in the roof is worse than a rat in the walls, harder to locate and harder to be rid of.

There is also a science in the laying of roofs. Study that seriously before your roof is laid and see that it is laid scientifically. A careless or dishonest workman may make a bad roof of the best roofing material.

Next to water leaking through the roof, your worst elemental enemy is wind. Weather leaks through the siding and about the windows and doors are leaks in your purse. It is not an uncommon thing in any city for a householder to throw two tons of coal every winter through the cracks in his house.

Two tons of coal at $10 a ton is equal to the interest at 5% on $400. Forty dollars added to the cost of material and labor put into the leaky house would have saved all this coal. When you are planning your house take a day off and look at all the varied kinds of felts and papers, fixtures and fabrics that are on display designed to "stop a leak to keep the wind away." Among them you will find something vastly superior to the old tar paper and back plaster, and something that will probably cost you no more money. Remember this, that builders these days know better how to build a weatherproof house than they did 20 years ago. Don't let any behind-the-times contractor build your house.

Here is something worth remembering. An attic floor with insulation is one of the best fuel savers ever devised. Build two houses side by side just alike except that one has an attic floor insulated and the other no attic floor at all, and when snow is on the city roofs and temperature at a certain point, you will see the snow melt on one of the roofs and not on the other. The coal bill in one will be larger than in the other. It costs money to melt snow on your roof.

If you buy a house already built assure yourself that its roof is waterproof and its walls weatherproof. Know that the man who built it is an honest builder. If ever you find yourself obligated to pay for a home with unmendable leaks in it the knowledge of the leaks will cut down your enjoyment of the home even more than the leak will drain your purse. Any construction that will save fuel is cheap, for fuel will be continuously dear. Two tons of coal a year will pay the premium on a snug little life insurance policy.

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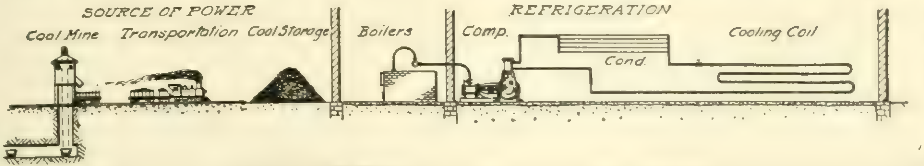
HEATING engineers will be called upon sooner than expected for war service, as a tremendous problem has already arisen in connection with the drying of fruits and vegetables. Due to the scarcity of tin, the manufacture of tin cans, it is announced, has come practically to a standstill and means must be found at once for drying such foodstuffs on a large scale. It is stated that the drying of fruit and vegetables is well understood abroad and has had an important bearing on the prolongation of the war. According to this information there are three types of apparatus in use, one for the household, a larger plant for community service and a still more elaborate outfit for the regular, organized drying industries. The product is packed in paper cartons and in this form may be readily transported and stored. The possibilities of the food-drying industry have long been understood but with the conditions brought about by the war emergency to spur it on, this industry is likely to develop to imposing proportions, especially when it is considered that the operation of such units will require almost as much skilled attention as their design.

A SIGNIFICANT step was taken recently when conference committees of the National District Heating Association and of The American Society of Heating Engineers met together to discuss ways and means for a closer co-operation between the two organizations. There has been considerable co-operation in the past, but if the present plans are carried out, we may expect to see shortly a joint professional meeting which would undoubtedly have important results. The truth of the matter is that while the two associations are sufficiently distinct in scope and purpose to justify and really require different organizations, there are many points on which their interests are identical. The principal reason for a separate organization is the so-called "commercial" character of the district heating engineers' association, as compared with the more technical character of the "American society." From the point, however, where the heating medium leaves the distribution main and enters the building the problem becomes one of heating pure and simple and here the interests of the two bodies are the same. It would seem that nothing but benefit for all concerned could result from a closer co-operation of the two societies.

ON ACCOUNT of the abnormally cold May, during which heating plants generally were continued in operation, the monthly weather charts appearing regularly in The Heating and Ventilating Magazine during the heating season, will include May this year. The May charts will appear in the July issue.

AIR COOLING AND REFRIGERATION



Elements of Refrigeration

The process of refrigeration is closely analogous to that of heating, the principal difference being that the medium used for refrigeration vaporizes at a much lower temperature than the water used to produce steam. While there are several agents which are used for refrigerating purposes there are general essentials which make a gas desirable and certain objections which accompany each gas which make it more or less undesirable.

For instance, *anhydrous ammonia* (which is most commonly used for this purpose) boils or vaporizes under atmospheric pressure at 28° F. below zero. Its main objection lies in the fact that its gas is dangerous to human life. *Carbon dioxide,* which is another agent sometimes employed, has the advantage of being non-explosive, non-inflammable and is not dangerous to human life unless in excessively large quantities. It has the disadvantage, however, of boiling or vaporizing at a very low temperature (this being 110° F. below zero) which results in requiring a very high pressure in order to liquefy it. When used, this gas must be compressed to 750 or 1,000 lbs. per square inch, which requires excessively strong piping and expensive apparatus. The agent itself is non-corrosive and, together with ordinary air, is considerably used for cooling on shipboard. *Sulphur dioxide* has a boiling point of 14° F. below zero which is a very desirable temperature and will liquefy at a much lower pressure. Its chief disadvantage is its lightness requiring large and cumbersome machinery to compress the cubic footage required, owing to its high specific volume.

For purposes of discussion the most common agent, namely anhydrous ammonia, will be assumed as the agent although the other gases follow a similar cycle of operation, except with varying temperatures and pressures according to the agent employed.

COMPARISON OF HEATING AND REFRIGERATING PROCESSES.

To draw the parallel more closely between heating and refrigeration the reader is referred to Fig. 1 in which A indicates a steam boiler partially filled with water at atmospheric pressure under which conditions the boiling point will stand at 212° F. Owing to the outside atmosphere surrounding this boiler being of a lesser temperature than 212° it is necessary to raise the temperature of the water to its boiling point in order to vaporize it, this rise in temperature being artificially produced by the building of a fire beneath the boiler under which conditions the water is raised to 212° and steam is produced. Now in B assume that the boiler is filled with anhydrous ammonia which, as already has been seen, has a boiling temperature of 28° F. below zero. The only difference between this boiler and the first one is the fact that the atmosphere surrounding the boiler contains sufficient heat to boil the liquid without the use of the fire. Therefore the ammonia vaporizes and turns into ammonia gas just as water vaporizes and turns into steam.

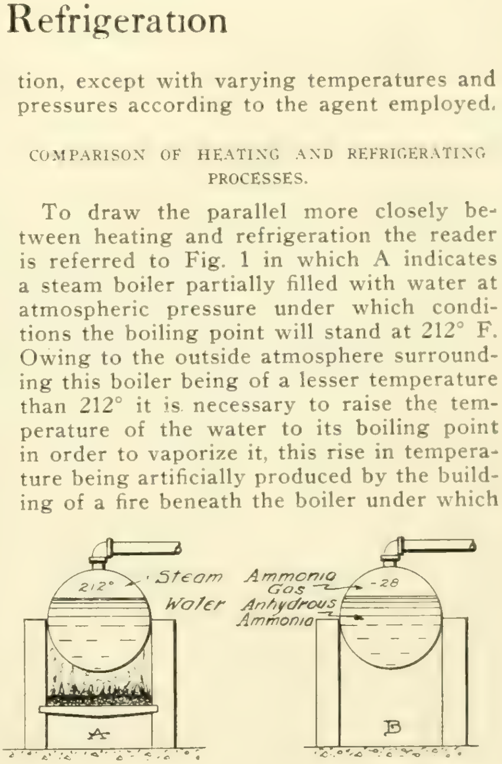


FIG. 1—COMPARISON OF HEATING AND REFRIGERATING PROCESSES.

If it was necessary to build a fire underneath the water in order to supply the latent heat required for vaporization, it is self-evident that the heat furnished by the fire would be absorbed by the water and steam in the process of vaporizing, this being termed the "latent heat of vaporization." When the ammonia vaporizes a similar action takes place; that is to say, latent heat to the extent of 573 B.T.U. per pound, is absorbed in the vaporizing of this agent. As the heat, however, in the case of the ammonia was supplied *not by the fire* but by the surrounding *air,* this results in the withdrawal from the surrounding air of a large number of B.T.U. depending upon the quantity of ammonia vaporized and the falling temperature of the air for, of course, when the air temperature is reduced to the temperature of the evaporating ammonia (or 28° below zero) further heat exchange cannot take place and the ammonia would cease to evaporate just as the water in the boiler will stop boiling when the temperature of the fire falls to less than 212°. In reality, however, it is never necessary to reduce the surrounding air to this extreme point and, therefore, the heat which the air draws from some other source continues to be absorbed by the vaporizing ammonia and the process becomes a continuous one.

REFRIGERATING AGENTS EXPENSIVE AND MUST BE RE-USED.

If the refrigerating agents were as cheap as water this vaporizing is all that would be necessary to produce artificial refrigeration, but unfortunately, this desirable feature of cheapness has not yet come to pass and all the complication of refrigeration systems is almost entirely due to the efforts made to preserve and use again the refrigerating medium. If the ammonia gas, after its evaporation, is to be retained and re-used two things are necessary; first, its heat, which it has absorbed in the process of vaporization, must be removed and, second, it must be changed from a gas back to its liquid form ready to begin another cycle

The most simple process of removing the heat consists of compressing the gas to a very high pressure which is accompanied by corresponding increase in temperature. Reference to the table presented in last month's issue shows the vaporizing temperature for any given pressure; thus a steam boiler operating under 100 lbs. pressure requires a certain temperature to evaporate water, this temperature being much higher than when operating under atmospheric pressure. So, also, the boiling point of ammonia under high pressure is raised and the problem is simply to produce pressure high enough so that the ammonia will not boil even at ordinary atmospheric temperatures. This increase in pressure is accomplished by means of a piston operating in a cylinder in a manner exactly opposite to that of the ordinary simple steam engine. In the steam engine steam comes in as a gas compressed under more or less of a high pressure and expands behind a piston driving the piston forward and producing power at the flywheel. With the ammonia compressor the ammonia gas enters the cylinder under little or no pressure and is compressed by the backward movement of the piston which is operated by power applied to the flywheel end; this results in the gas being compressed and driven out through the discharge pipe with a corresponding increase in its temperature.

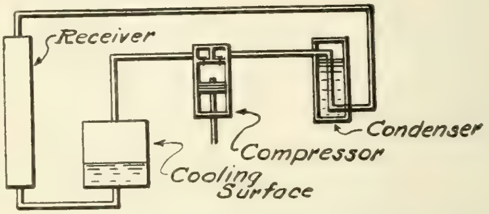


FIG. 2—DIAGRAMMATIC SKETCH OF REFRIGERATING PROCESS.

The compressor does not change the gas to a liquid but owing to the great increase in temperature it is possible to cool the gas to a point where the high pressure under which it is compressed will result in its liquification. This is done by passing the high-temperature, high-pressure gas through some sort of cooling surface, which may be pipes exposed to the outside air, pipes submerged in cold water or any other method whereby the sensible heat is absorbed by the cooling agent employed in the condenser; this results in a drop in temperature of the ammonia gas to a point where it condenses and returns to its liquid form. The liquid ammonia thus produced passes into a liquid receiver where it is stored, still under its high pressure, and from which it is admitted through a valve into the vaporizer first illustrated, ready for a second vaporization and a repetition of the cycle.

Fig. 2 gives a diagrammatic sketch of the means above described, the gas vaporizing in the cooling surface and producing refrigeration; it then passes out of the pipe at the top and over to the compressor where it is compressed and its temperature rises to a high degree; from the compressor the hot gas goes to the condenser where it is cooled by the cooling water and condensed; from this point it flows back as a liquid under high pressure and moderate temperature to the receiver ready to again enter the evaporizer for a second trip.

"DRY" AND "FLOODED" SYSTEMS.

Where all the ammonia is evaporated into ammonia gas and returns to the compressor as such the system is called the "dry" system but where some of the ammonia, after passing through the vaporizer, remains in liquid form and is caught in an accumulator and re-passed through the vaporizer while the gas goes to compressors it is termed the "flooded" system. In the dry system the heat is transferred from the liquid outside of the coils to the gas inside the coils, while in the flooded system the heat transmission is between liquid on both sides of the coil and the transmission, being from liquid to liquid, is therefore much more rapid. For this reason a flooded system will give more rapid refrigeration and require less refrigerating surface but requires a greater initial amount of ammonia.

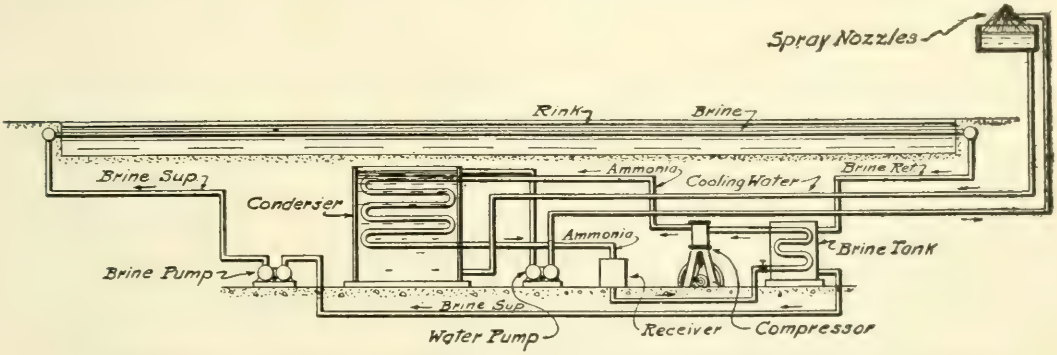
Notes

Last October the new Winter Garden in San Francisco was opened to the public. This is an artificial ice skating rink 275 ft. long by 144 ft. wide, the ice portion being 210 × 90 ft. The ice in this ring is frozen by brine cooled in a cooling tank by the expansion and vaporizing of ammonia as indicated in the diagram.

The rink which was constructed under direction of J. T. Ludlow, consulting engineer, of San Francisco and was built over the floor of the roller skating rink which previously utilized the same space. On top of the floor was laid 8 in. of sawdust and water proof roofing, this being covered with a sprinkling of fine sand. On the sand was placed 55,000 lin. ft. of 2 in. steel pipe with a total of only 134 joints, all other junctions being oxy-acetylene welded

The ice plant consists of two 50-ton compressors operated by 100 H.P. motors, and 2,500 gal. of 75% brine solution are circulated through the rink coils by the brine circulation pumps, the rate of circulation being about 15 g.p.m.

It is endeavored to hold the ice as near 32° F. as possible as this gives the best surface for skating.



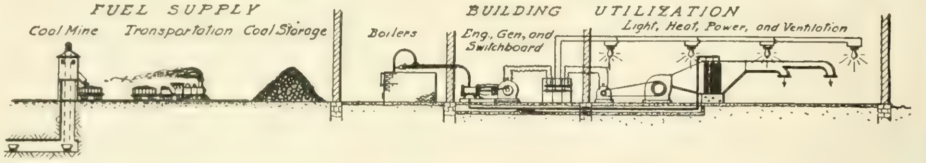
ARRANGEMENT OF SYSTEM FOR FREEZING ICE IN THE NEW WINTER GARDEN, SAN FRANCISCO.

The cooling of the brine takes place in the brine tank in which is placed an ammonia coil inside of which the ammonia expands and absorbs the heat. The expanded gas is then compressed in the compressor and its high temperature cooled off in the condenser; it then returns into the receiver ready for use. This is an "indirect" system owing to the use of brine in the rink pipes and not ammonia.

The cooling water is kept from overheating by being pumped by the water pump up to a tank on the roof into which it is sprayed.

Pittsburgh is the proud possessor of a new artificial ice skating rink. This is known as the Duquesne Garden and was secured through the conversion of an old street car barn into a rink of the first water —or ice. This rink is frozen by an ammonia-brine system operated entirely by alternating-current motors.

POWER PLANT ENGINEERING



The Design of a Building Power Plant

In designing a power plant for any building the engineer has a problem on his hands of a considerable magnitude; not so much as to size and capacity, perhaps, as to the making of basic decisions first, regarding fundamental essentials of the plant.

For instance, a power plant means high steam pressure but what shall be selected as a "working pressure" for the plant? And what type of boiler shall be used, firebox, horizontal return tubular, downdraft, water-tube or what? Shall a feed-water heater be used, and, if so, of open or closed type? What kind of engines, simple, compound, condensing or non-condensing? Or shall steam turbines be substituted? Will the generators be direct or belt-connected? What kind and what voltage of current is to be adopted? What heating system is going to be used and how are the returns to find their way back to the boilers? These are only a few of the leading questions which must be finally decided before the design of the plant can be undertaken intelligently.

Other important issues consist of the fuel to be used, the grates or stokers to be installed, whether natural, forced or induced draft is to be selected, size and height of chimney, method of ash handling, method of coal handling, amount of coal storage, the question of economizers, pure feed water, scheme of boiler feeding, devices for accurately testing the plant operation such as water weighers, coal scales, etc.

IMPORTANCE OF SPACE CONDITIONS.

Undoubtedly one of the most important elemental factors is that of space conditions; these may even influence the type of boilers, it often being found that boilers of one type cannot be installed in places where boilers of another style can be used with advantage. In considering space conditions the height should also be looked into and the boiler room ought, by rights, to be two stories high; in some small installations and also in buildings with a high basement the boiler room may be only a single story high.

In high-pressure work it is desirable to take the steam out of the boiler through a high pipe bend (generally of a U-shape) but with a low ceiling connections as shown in Fig. 1 are used; such a layout gives a swing nipple at A and another at B. This type of connection is also used where the horizontal distance between the boiler nozzle and the main steam header is not sufficient to permit the use of a bend.

TYPICAL POWER PLANT EQUIPMENT.

While every building has its own arrangement of power plant equipment, that shown in Fig. 2 may be taken as more or less typical, the main pieces of apparatus consisting of

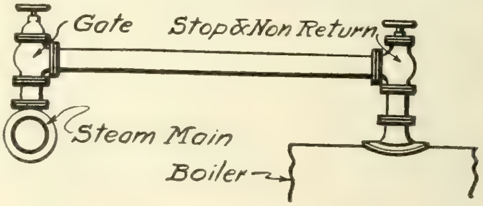


FIG. 1—STEAM PIPE CONNECTION TO BOILER WHEN CEILING IS LOW.

- Boilers
- Engines
- Feed Water Heater
- Boiler Feed Pumps
- Back Pressure Valve
- Oil Separator
- Exhaust Head
- Steam Separators
- Traps

As far as the boilers are concerned there are several types in use, the three most common types being the fire-box, horizontal return tubular, and water-tube. Without doubt the old reliable H.R.T. is the most popular, in spite of the fact that the brick settings make these boilers more expensive than the firebox type. The steel boiler, without a brick setting, undoubtedly makes the cheapest steam producing unit suitable for power plant use. Down-draft boilers of steel, either brick set or portable, are also good where smoke considerations and cheap coal are essential, but the expense of a stoker unwarranted. For the best work water-tube boilers of Babcock & Wilcox, Heine, or Sterling types are used, these being capable of burning almost any kind of fuel smokelessly when equipped with a good make of automatic stoker.

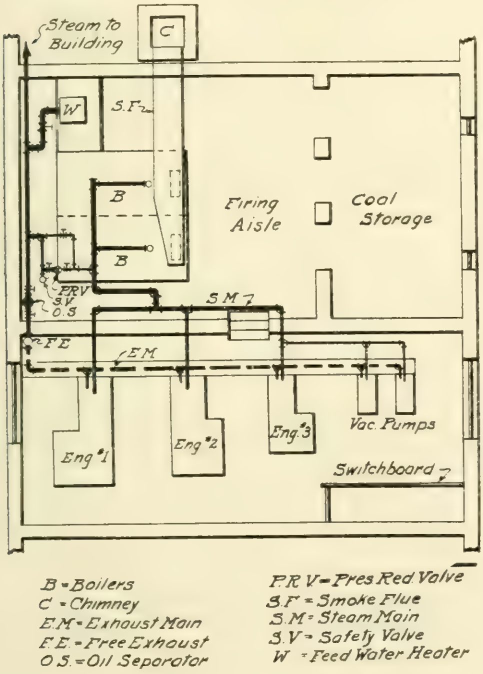


FIG. 2—TYPICAL EQUIPMENT FOR POWER PLANT.

In general high-pressure boilers may be classified into two classes—fire-tube and water-tube. The fire-tube boilers may be sub-divided into the return tubular (such as the common H.R.T.) and the fire-box tubular in shape somewhat resembling the common locomotive boiler.

INSTALLATION OF AUTOMATIC STOKERS USUALLY JUSTIFIED.

The automatic stoker is a very expensive proposition often costing as much, and sometimes even more, than the boiler to which it is applied. The results attained in the long run, however, will usually justify the cost, especially with the advancing prices of the better grades of coal. Of course, the ideal method of supplying coal to a stoker is from an overhead bin sometimes supplemented by a travelling feed spout but in the small building power plant such refinements are not usually adopted. The coal is most generally stored in bins on the same floor level and is then shoveled by hand into the furnace or stoker. Consideration should be given the fact that the level of a stoker is liable to be 5 ft. to 7 ft. above the floor and that the stoker should either be set in a pit or an elevated shoveling platform provided.

All steel boilers must have space to allow for the withdrawal and replacement of tubes which may become defective later. Space must also be provided for the necessary access doors, and as a general rule it may be said that of all boilers on the market only the H.R.T. can be set in a continuous battery, the water-tube and down-draft can be set in batteries of not over two, and the fire-box should be set singly.

Breeching considerations may sometimes influence a decision on boilers, the water-tube having the uptakes located at the rear and the other types at the front.

Ashes in the case of the use of ordinary grates are, of course, removed from the ash pit. With down-draft boilers the clinkers are pulled from the upper grates and the ashes removed from the ash pit; with stokers the usual procedure is to dump the ashes from the interior end of the stoker down into a steel ash hopper with an iron gate from which the ashes are removed from time to time by opening the gate. From this point the ashes can be transported by means of an ash car, wheel barrow or steam jet system to any point desired. Forced draft is always a desirable accessory to any power plant boiler installation, as it develops a greater boiler horsepower, more quickly, and at small cost, if steam operated. Forced draft cannot be used with chain grate stokers but is an absolute requirement for the underfeed types of stokers. Induced draft is so seldom used in such cases as to make its consideration unnecessary here.

ACCESSORIES NECESSARY WITH HIGH PRESSURE BOILERS.

To operate a high-pressure boiler successfully certain accessories and apparatus are necessary; these may be itemized as follows:

(a) Water column, gage glass and trycocks to indicate the level of the water in the boiler.
(b) A pressure gauge reading to 50% above the operating pressure.
(c) A safety valve set at about 10 lbs. above the normal working pressure.
(d) A blowoff valve and tank with drain to sewer so as to allow the blowing-off of impurities from the boiler water and the emptying of the boiler.
(e) A steam nozzle and steam pipe to carry the steam away as it is produced.
(f) A manhole for access to the interior.
(g) Handholes for cleaning where access is not possible from the interior.
(h) Some sort of apparatus to feed in the water against the boiler pressure—such as an injector, boiler-feed pump, etc.
(i) A furnace or stoker in which to burn the fuel.
(j) A chimney to carry off the gases of combustion.

Besides these certain other features are desirable but not absolutely necessary, such as

(k) Fusible plug which melts when the water line gets below it, and allows the steam to blow out and drown the fire.
(l) High and low water alarms which blow a whistle to notify the firemen when the water line is getting too high or too low.
(m) A feed-water heater to heat the feed water to as near the boiling point as practical so as to subject the boiler to as little temperature strain as possible when being fed with water.
(n) A system of forced draft for quick control of the steam produced.
(o) An automatic damper regulator which controls the draft so as to maintain the steam pressure at a constant point regardless to the size of demand made on the boiler.

The fusible plug is gradually passing out of use in the boilers of better plants, its place being taken by water columns with high and low water alarms.

Notes

One of the most interesting facts in regard to the use of exhaust steam for heating work is the argument and figures of actual coal consumption presented by some investigators showing that it takes less coal to heat a building if the steam is generated at high pressure and passed through an engine before entering the heating system than if it enters the heating system direct through a pressure reducing valve. Theoretically this is all wrong but theory cannot contradict actual facts—if the facts *are* indeed actual.

The data presented in support of this contention, however, seems to be so simple and backed by such substantial sponsers that dispute of the basic fact is difficult. If, on Sunday, with the power plant shut down, it takes a larger quantity of coal to hold up the temperature in a factory than it does on a workday with the same outside temperature, how is it possible to account for the difference? While it is entirely within reason that such a thing might happen once in a while, due to higher winds on Sunday, etc., how can it be explained that that a power plant, added to a heating plant which had been run for years, saved 100 tons of coal during the very next heating season although the average winter temperature was practically the same?

Any of our readers who have any facts on this interesting subject, either pro or con, are asked to send them in for discussion in this department.

The government gives some good suggestions regarding methods of checking up short weight coal deliveries in their "Measurements for the Household" issued by the Bureau of Weights and Standards. Other chapters deal with the theory of heat, heating valves of fuels, various kinds of thermometers, and on the amount of ice melted in various refrigerators tested. Atmospheric humidity, heating of rooms and water, gas and electric meters are also discussed.

Those of our readers interested in smoke prevention will find much useful information in Bulletin No. 39 issued by the Bureau of Mines, Department of the Interior, entitled "The Smoke Problem at Boiler Plants." This bulletin is a preliminary report by D. T. Randall and covers briefly the requirements of the smoke ordinances of various cities and the methods which may be used in endeavoring to comply with same.

Further discussion of the subject is given in Bulletin No. 49 by Samuel B. Flagg in which proposed smoke ordinances are recommended and the ordinances of several cities quoted verbatim. The smoke question is a vital one in every power plant and should be considered from all angles before a decision is reached as to what equipment is necessary and how exacting are the requirements under which the plant must be operated.

CORRESPONDENCE

Fuel Economy and Humidification.

Editor Heating and Ventilating Magazine:

In The Heating and Ventilating Magazine for March, 1917, arguments by Professor William Kent against artificial humidification are presented. The first point which he makes is that there is no resulting economy in heat through ability to maintain a lower indoor temperature. To prove this, he presents a mathematical analysis which is fundamentally at fault at the very start. He assumes that the heat used to generate the moisture required for humidification is lost; in other words, that it is not available for warming the apartment. Upon the basis of this assumption, his figures are intended to prove that the heat saved by reduced radiation, due to the lower indoor temperature of the humidified condition, is less than expended in generating the vapor for humidification.

Kent's conclusions are criticized by Mr. Charles E. Manierre who questions the accuracy of his figures. Mr. Manierre, however, says nothing about what becomes of the heat used to produce the vapor. This is a question which has bothered a great many people. With myself, I found an answer by trying the matter out by actual demonstration. Steam from the heating system was discharged in the air of the rooms by the Steamo air moistener. This steam is not taken from the radiators, but from the branches and risers. In this way the radiators may be used or not as desired, while steam for humidification is always available. The result of my experience has been that during about one-half of the period of a heating season, there is no day that a radiator is turned on. During the other portion of the season there are very short periods during which all of the radiation may be on or all off, but, as a rule, a reduced amount of radiation only is used. The fact is that for a very large part of the heating season, the steam required to produce the humidity desired, also heats the apartment with no heat from any other source. This, I think, is proof that Professor Kent is wrong in his assumption. At all events, it is my advice to any one who wishes to settle the matter for himself to try it.

Some engineers whom I know are now taking this fact into consideration, and specifying less radiation than formerly, planning to get a portion of the required heating effect from the steam liberated for humidification. This is an important matter and one well worth while looking into.

Professor Kent, in reply to Mr. Manierre, states, among other things, that he has lived in a humidified house, also in one that was not, and that he likes the dry air condition best. Professor Kent is considered a very eminent authority and when he makes a statement like this, people are liable to sit up, take notice and wonder what it all means. Especially when his preference is in opposition to physical fact. But I think if we will exercise our minds a little, we can get over the obstacle. As an illustration, it is generally undertsood that the habitual drinking of whisky is not beneficial. Now, if I should say that I preferred to drink it nevertheless, my statement would convince no one that it was a good thing to do. With humidity, however, not so well understood, we are in danger of being influenced by such a statement as that of Professor Kent's.

Chicago, May, 1917. A. B.

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Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from The Heating and Ventilating Magazine *on receipt of the stated price.*

Drying

The Theory of Drying and Its Application to the New Humidity Regulated and Recirculating Dry Kiln. 28 pp. U. S. Dept. Ag., Bul. 509—March 17, 1917. On drying of lumber. 50c.

Theory

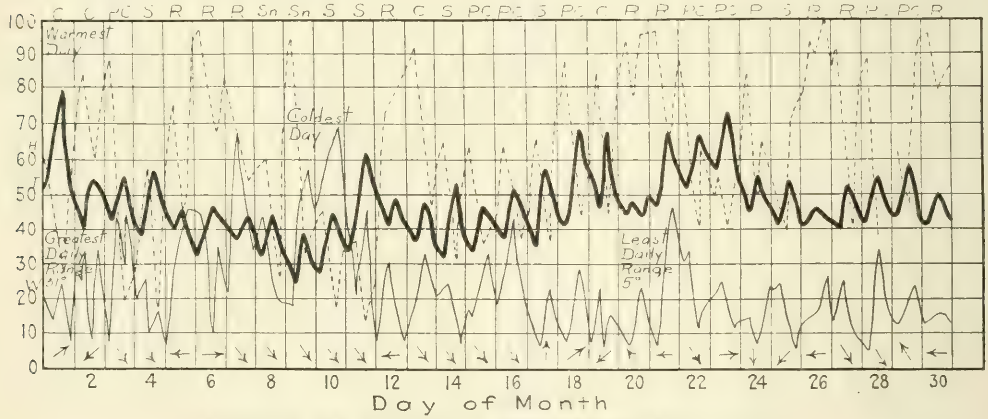
An Outline of the Theory of Heat Transmission and Absorption in Application to Ordinary Engineering Problems. John E. Bell, with discussions. Ills. 49 pp. Engrs' Soc. W. Penn., Pro—Jan., 1917. 60c.

Refrigeration

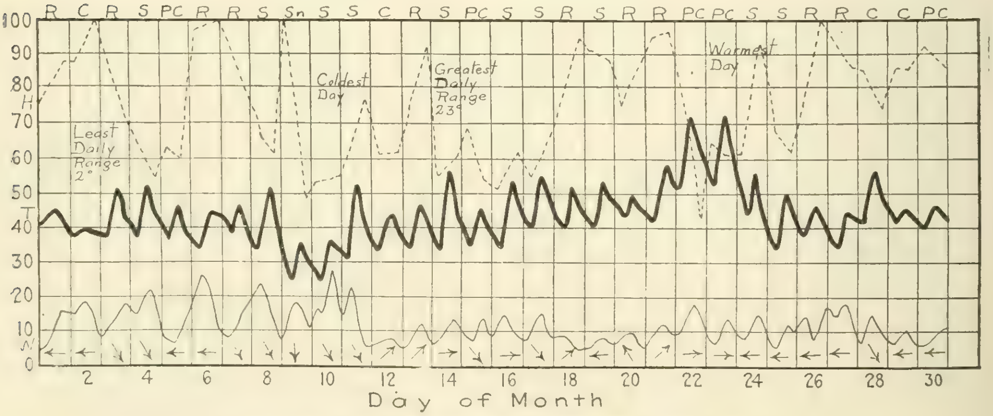
Absorption Plant for Distilled Water Ice. Ills. 1800 w. Prac. Eng., Chi.—March 1, 1917. Equipment of an Indianapolis plant. 20c.

The Weather for April, 1917

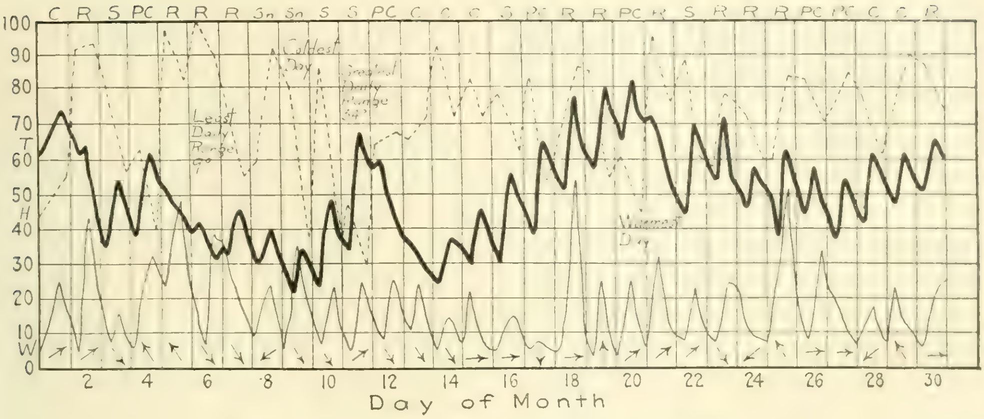
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	79	72	81	82	84
Date of highest temperature	1	23	20	18	23
Lowest temperature, degres F.	25	26	21	30	30
Date of lowest temperature	9	10	9	13	9
Greatest daily range, degrees F.	31	23	34	31	26
Date of greatest daily range	1	14	11	18	17
Least daily range, degrees F.	5	2	9	2	6
Date of least daily range	20	2	6	7	28
Mean temperature for month, deg. F.	47.2	44	50	44.8	53.7
Normal mean temperature for month, deg. F.	48.1	45.3	51	45.9	56.1
Total rainfall, in.	2.35	2.72	2.20	2.58	4.64
Total snowfall, in.	6.5	9.1	0.7	Trace	..
Normal precipitation, this month, in.	3.3	3.55	2.9	2.88	3.52
Total wind movement, miles	12942	7363	9043	10514	11247
Average hourly wind velocity, miles	18	10.2	12.6	14.6	15.6
Prevailing direction of wind	N. W.	N. W.	N. W.	N. E.	S.
Number of clear days	6	10	6	7	8
Number of partly cloudy days	10	6	11	7	13
Number of cloudy days	14	14	13	16	9
Number of days on which rain fell	9	10	12	18	14
Number of days on which snow fell	2	1	1	..	..
Snow on ground at end of month, in.	..	..	..	..	..



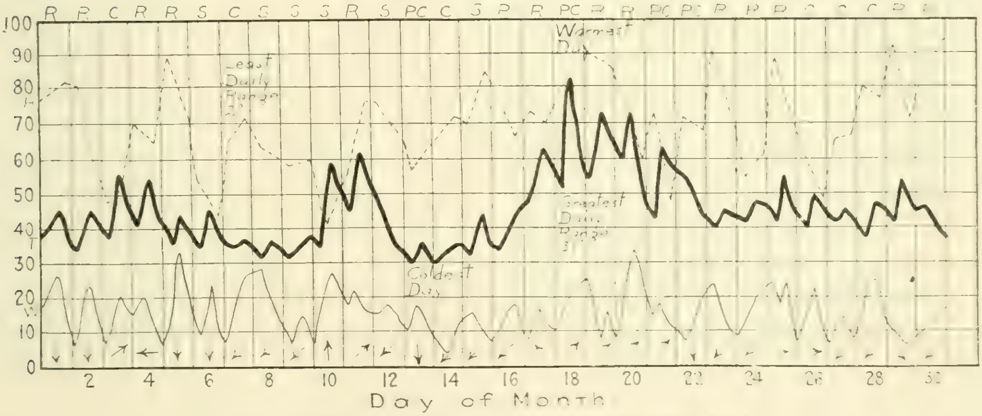
RECORD OF THE WEATHER IN NEW YORK FOR APRIL, 1917.
(Hourly Observations of the Relative Humidity are Recorded on this Chart.)



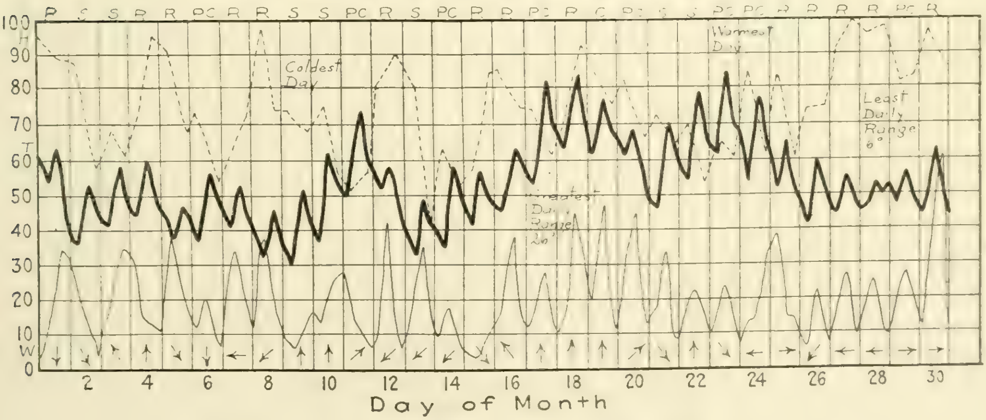
RECORD OF THE WEATHER IN BOSTON FOR APRIL, 1917.



RECORD OF THE WEATHER IN PITTSBURGH FOR APRIL, 1917.



RECORD OF THE WEATHER IN CHICAGO FOR APRIL, 1917.



RECORD OF THE WEATHER IN ST. LOUIS FOR APRIL, 1917.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Summer Meeting To Take Up War Problems.

Engineering problems pertaining to the the heating and ventilating of army buildings and the drying of foodstuffs will have a prominent place in the programme for the forthcoming summer meeting of The American Society of Heating and Ventilating Engineers, in Chicago, July 18-20. Already, in response to a request from the Government, President J. I. Lyle has appointed a committee, consisting of W. S. Timmis, W. H. Driscoll, W. H. Carrier, Dr. E. V. Hill and F. R. Still, to confer with Government departments on plans for utilizing the services of the heating profession.

One of the principal problems that will have to be met is in connection with the drying of vegetables and fruit, as all signs point to a scarcity of the tin can supply. According to methods already in successful operation abroad food thus dried may be packed in cartons and kept in good condition without losing its food value. Other problems will have to do with the equipment of camps and military hospitals.

At a meeting of the society's Boiler Testing Code Committee, held May 18, a revised report was drawn up for a standard code and it is stated that the report will be presented in shape for final adoption at the next annual meeting of the society.

New Year Book for Heating Engineers' Society.

The 1917 year book of The American Society of Heating and Ventilating Engineers has been issued, showing a total membership of 775. This is by far the largest number of members the society has ever had on its rolls. The list of members is arranged alphabetically and geographically, and there are also lists of officers and committees, chapters and local secretaries, charter and constitution, and past officers and calendar of past meetings, the whole making a booklet of 116 pages. The increase in membership for the year is 70 and Secretary C. W. Obert reports that 62 additional applications for membership were received after the year book was issued.

New York Chapter Discusses Military Matters.

Plans for the arrangement and equipment of military camps, such as Camp Whitman, in New York State, were taken up at the closing meeting of the New York Chapter. The principal speaker on this subject was Captain Weston E. Fuller, of the New York National Guard. He said that there would be 32 camps similar to Camp Whitman located in different parts of the country and that the problems of heating, ventilation, water supply, and drainage would all have to be decided upon shortly and carried out by civilian boards. So far practically no plans have been made for heating or ventilating barracks or portable hospitals.

The meeting opened with the installation of the new president, Frank K. Chew, and the other officers. The meeting was then turned over to the chairman of the evening, George W. Martin, who called upon President Lyle of the society to tell of the steps the society had already taken to co-operate with the Government. At a meeting that morning, at which a committee of the society conferred with President Byron T. Gifford and Secretary D. L. Gaskill of the National District Heating Association, suggestions were made as to how the two organizations could supplement each other's efforts, both for Government service and in the advancement of their ordinary interests as well. These suggestions included one for a joint meeting of the two societies.

President Gifford and Secretary Gaskill, both of whom were present at the dinner, were called upon to address the meeting. Mr. Gifford said that the success or failure of a central heating plant is largely an engineering problem and he bespoke the interest of the heating engineers in the work of the National District Heating Association. Secretary Gaskill had something to say about the part the West is prepared to play in the war, declaring that there need be no fear that the West will do its full part and will raise the necessary food to supply not only the people of the United States, but the Allies as well.

The concluding speaker was Past President Reginald Pelham Bolton who presented his well-known lecture, illustrated with lantern slides, on "Revolutionary Relics on Manhattan Island."

Annual Banquet of Michigan Chapter.

The Michigan Chapter held its annual dinner at the Fellowcraft Club, Detroit, with a large attendance of members and guests. William F. McDonald acted as toastmaster and introduced the various speakers. Prof. John R. Allen spoke on "The Engineer at School." He was followed by J. R. McColl, whose subject was "The Consulting Engineer"; by Charles A. Blaney, who spoke on "The Heating Engineer"; and by Fred R. Still, whose topic was "The Sales Engineer." The speaking was interspersed with music. James E. Degan, as chairman of the entertainment committee, successfully carried out the arrangements for the dinner. The menus contained, in addition to a list of the speakers and officers, a complete list of the chapter's members, showing a total of 99.

The May meeting of the chapter was held at the University of Michigan, Ann Arbor, May 26. The trip from Detroit was made by automobile, a stop being made at Westwood where a frog and chicken dinner was served. Arriving at the university the party was taken to the Engineering Building where Professor John R. Allen, who had charge of the meeting, and other members of the engineering staff addressed the chapter.

Illinois Chapter Holds Dinner Dance.

The Illinois Chapter wound up its season with a dinner dance at the Hamilton Club, Chicago, May 17. Following a lecture on the European war by Dr. Preston Bradley, dancing was indulged in to the music of Henschell's orchestra, the ladies being well represented.

Automatic Heat Control Discussed by Eastern Pennsylvania Chapter.

"Automatic Control as Applied to Heat Regulation," was the principal topic for discussion at the May meeting of the Eastern Pennsylvania Chapter, held at the Engineers' Club, Philadelphia, May 10. S. E. Plewes presented the subject and exhibited models of improved present-day devices, illustrating the great advances made in recent years. Mr. Plewes attributed the "positive reliability" of modern automatic control, as distinguished from manual control, to the highly-developed design and special materials now used in the manufacture of temperature-regulating devices.

Among those present was John F. Hale who has returned to Philadelphia from Chicago, having recently been elected vice-president of the Braemer Air Conditioning Corporation, of Philadelphia, Mr. Hale will transfer his activities from the Illinois to the Eastern Pennsylvania Chapter.

The May meeting was the last for the season, the next regular meeting being scheduled for October 11.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Master Steam Fitters' Convention Postponed.

At a meeting of the board of directors of the National Association of Master Steam and Hot Water Fitters, held May 17, it was voted to temporarily postpone the convention of the association, which was to have been held in Chicago, June 11-14, with headquarters at the Hotel Sherman. This action was taken "on account of the uncertain conditions brought about by our country being in a state of war."

New York State Association.

Officers were elected as follows at the annual convention of the New York State Association of Master Steam and Hot Water Fitters, held in Albany, May 8: President, John R. Sheehan, Schenectady; vice-president, H. J. Brandeles, Utica; secretary-treasurer, W. J. Olvany, New York; corresponding secretary, Henry B. Gombers, New York; sergeant-at-arms, W. T. Cantwell, Utica. The new directors are: C. Ashmunsen, Albany; W. F. Devendorf, Rochester; John J. Doherty, Poughkeepsie; W. T. Lane, Buffalo and E. F. Joy, Syracuse. A dinner at the Hotel Hampton followed the close of the convention.

Deaths.

S. Louis Barnes, former president of the National Association of Master Plumbers, died at his home in Germantown, Philadelphia, May 9, from cerebro-spinal meningitis. Mr. Barnes was 48 years old and had been in good health up to the time of his last illness which began April 18. Mr. Barnes was president of the national master plumbers' association at the time when it was under the most extensive government prosecution and became well-known for his efforts in maintaining the integrity of the organization.

National Pipe and Supplies Association Holds Annual Convention.

A record attendance of 450 members and guests, made up almost entirely of manufacturers and jobbers, was registered the annual convention of the National Pipe and Supplies Association which was held in Philadelphia, May 9, at the Bellevue-Stratford Hotel.

One of the principal addresses was made by James Francis Burke, general counsel for the Pittsburgh Chamber of Commerce, who spoke in a patriotic vein. A symposium on the trade outlook brought out the fact that prices were high and materials hard to obtain, so that a further rise in prices is to be expected. J. J. Kennedy, sales manager for the National Tube Company, reported a shortage in pipe due to the requirements and export trade, as well as to the shrinkage in production for lack of sufficient labor. W. E. Manning, sales manager of the Youngstown Sheet & Tube Company, expected the tendency toward slow deliveries would prevail for some time. John Duncan, sales manager of the Wheeling Steel & Iron Company, expected an advance and called attention to the comparatively small advance up to date in the cost of pipe. J. F. Conran, sales manager of the Standard Sanitary Mfg. Co., gave an encouraging report and stated that a great many buildings were being rebuilt which was offsetting to a degree the let-up in new building work. L. M. Johnson, general manager of the A. M. Byers Co., referred to the rapidly-increasing cost of raw materials, making the immediately future an uncertain quantity.

COST OF DOING BUSINENSS.

The association's recent investigation on the cost of doing business in 1916 showed that 73 replies had been received. Of these, 49 showed the following averages: Gross profit, 26.13%; cost 18.08%; net profit, 8.05%. These reports included interest charges on both borrowed money and capital. Sixty-three reports, which did not include the interest items, showed the following averages: Gross profit, 25.8%; cost, 15.55%; net profit, 10.25%.

Reports on the volume of business done so far this year showed that the volume was 39.83% greater in value, but about the same in tonnage.

NEW OFFICERS.

The new officers elected are:

President, L. C. Huesmann, Central Supply Co., Indianapolis; first vice-president, George V. Denny, Georgia Supply Co., Savannah, Ga.; second vice-president, R. S. Woodruff, C. S. Mersick & Co., New Haven, Conn.; secretary-treasurer, Geo. D. McIlvaine, Pittsburgh.

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Advisory Board: W. M. Pattison, W. M. Pattison Supply Co., Cleveland; A. E. Ford, Ford & Kendig Co., Philadelphia; Alex. B. Pierce, N. O. Nelson Mfg. Co., St. Louis, Mo.

NATIONAL DISTRICT NDHA HEATING ASSOCIATION

Committee Named to Co-operate with Government.

President Byron T. Gifford has appointed the following committee to confer with Government authorities regarding the heating of groups of buildings used for military service: Davis S. Boyden, Boston; Charles R. Bishop, North Tonawanda; and George W. Martin, New York.

◆

Building Operations for April.

A decrease of 8% in the total of building operations for April, 1917, as compared with the same period in 1916, is shown in the reports from 115 cities, as compiled by the *American Contractor*, Chicago. The total was $86,100,925 as compared with $94,029,102 in April, 1916. Considering the possible effects of the war declaration, the loss of but 8% for April is looked upon as a remarkably good showing.

Among the cities reporting gains are: Akron 81%; Atlantic City 472%; Boston 17%; Detroit 38%; Erie 144%; Hartford 10%; Los Angeles 115%; Milwaukee 131%; Newark 38%; St. Louis 70%; and Worcester, Mass., 76%. Important cities showing losses were: Chicago 16%; Cincinnati 10%; Cleveland 7%; Minneapolis 58%; New York City 40%; Philadelphia 19%; Pittsburgh 12%; Rochester 52%; San Francisco 60%; Washington, D. C., 40%.

VENTILATION.

Number of Air Changes.

The table below shows the changes of air per hour, or the cubic feet per minute (C.F.M.) per occupant, recommended for various rooms in hospitals, sanitariums, private hospitals in other buildings, and similar apartments used for medical purposes.

HOSPITALS

ROOM	SUPPLY		EXHAUST	
	C.F.M. Per Occupant.	Minimum Air Changes Per Hour.	C.F.M. Per Occupant.	Minimum Air Changes Per Hour.
Anesthesia	..	8 (with local control)	..	12
Autopsy	..	4	..	8 to 10
Bakery	.	none	..	10
Baths, Toilets, etc.	..	none	..	12
Boiler (large)	..	10	..	none
Clothes Storage	..	none	..	6
Dairy, Meats, etc.	..	none	..	8
Dark	..	4	..	6
Delivery	60	8	60	8
Dining	20	6	30	8
Doctors Wash	..	none	..	8
Dressing	..	none	..	6
Drying Closets	..	none	..	20
Electrotherapeutic	..	6	..	8
Engine	..	4 to 6	..	8 to 10
Examination	..	6	..	6
Gymnasium	30	8	30	8
Hydrotherapeutic	..	6	..	8
Ice Making	..	none	..	4 to 6
Instrument (Prep.)	..	none	..	6
Isolation	30 to 60	6	30 to 60	6
Kitchens	..	6 to 8	..	15
Laboraties	..	6	..	8 to 10
Laundry (Small)	..	none	..	10
Laundry (Large)	..	6 to 8	..	12
Lockers	..	none	..	6 to 10
Machinery	..	4 to 6	..	8 to 10
Marking and Sewing	..	none	..	6
Meats, Dairy, etc.	..	none	..	8
Operating	100	10	100	10 (See Note A)
Pantries (Serving)	..	none	..	12
Plaster	..	4	..	6
Preparation (Inst.)	..	none	..	6
Pus Dressing	..	5	..	8
Pump and Refrigeration	..	4 to 6	..	8 to 10
Recovery	..	8	..	8
Refrigeration and Pump	..	4 to 6	..	8 to 10
Serving Pantries	..	none	..	12
Sewing and Marking	..	none	..	6
Shops, etc.	..	none	..	6
Solarium	..	4	.	4
Slop Sink Closets	..	none	.	12
Sterilizing Room	..	8	.	12
Stores	..	none	.	[illegible]
Toilets, Baths, etc.	..	..	.	[illegible]
Utility	..	none	..	[illegible]
Waiting	30	6	30	6
Wards (Gen'l)	30 to 60	6	30 to 60	6
Wards (Contagious)	100	10	[illegible]	10
Wash (Doctors)	..	none	..	[illegible]

Note A—Operating Rooms should have auxiliary top outlet in exhaust system.

VENTILATION.

Number of Air Changes.

The table below shows the changes of air per hour, or the cubic feet per minute (C.F.M.) per occupant, as recommended by the best authorities, for various rooms in hotels and their various service departments and in libraries.

HOTELS

ROOM	SUPPLY		EXHAUST	
	C.F.M. Per Occupant	Minimum Air Changes Per Hour	C.F.M. Per Occupant	Minimum Air Changes Per Hour
Ball Rooms	30	8	30	8
Banquet Hall	30	8	30	8
Bathroom (Private)	..	none	..	10
Boiler Room (Large)	..	10	..	none
Dining	30	8	30	8
Engine, Large	..	4 to 6	..	8 to 10
Kitchen	..	6 to 8	..	15
Laundry	..	6 to 8	..	12
Locker Room	..	none	..	10
Pump Room (Large)	..	4 to 6	..	8 to 10
Sleeping	..	none	..	note—see note "A"
Toilets (Main)	..	none	..	12
Toilets (Private)	..	none	..	10
LIBRARIES				
Administration Center	..	6	..	6
Book Rooms	30	6	30	6
Galleries, Public	..	4	..	4
Galleries, Picture	..	4	..	4
Lecture Rooms	30	8	30	8
Locker Rooms	..	none	..	10
Lobbies—Large Bldgs.	..	8	..	none
Museums	..	4	..	4
Reading Rooms	30	6	30	6
Stack Room	..	none	..	4
Toilet Rooms	..	none	..	10

Note A—Sleeping rooms with connecting baths can be ventilated through the bath.

VENTILATION.

Number of Air Changes.

This table shows the changes of air per hour or the cubic feet (C.F.M.) per minute per occupant, as recommended by the best authorities, for various rooms in schools, institutes, colleges, universities, and other educational buildings.

SCHOOLS

ROOM	SUPPLY		EXHAUST	
	C.F.M. Per Occupant	Minimum Air Changes Per Hour	C.F.M. Per Occupant	Minimum Air Changes Per Hour
Auditorium	20 to 30	8	30	8
Board	..	6	..	6
Chemical Lab.	30	6	30	6
Chemical Cabinets	none	none	100 per cabinet	..
Class	30	6	30	6
Coat	none	none	..	8
Commercial	30	6	30	6
Corridors	..	See Note A	..	..
Domestic Science	30	6	40	8
Drawing	30	6	30	6
Dress Making	30	6	30	6
Forge Shop	See Note B	..	..	See Note B
Forges	200 c.f.m	per forge	400 c.f.m.	per forge
Gymnasium	30	8	30	8
Kitchen for Lunch Room	..	6 to 8	..	12
Kitchen for Cooking Class	30	6	50	10
Kitchen (Model)	..	6	..	8
Lecture	30	8	30	8
Library	30	7	30	7
Locker	none	none	..	10
Lunch	..	6	..	10
Machine Shop	30	6	30	6
Model Apart.	..	4 to 6	..	4 to 6
Office—General	..	6	..	6
Office—Private	none	none	none	none
Physical Lab.	30	6	30	6
Recitation	30	6	30	6
Shower Baths	none	none	..	10
Swimming Pool	..	4	..	10
Toilets	none	none	..	10 to 12
Wardrobes	none	none	..	8
Wood Working	30	6	40	8

Note A—Air supply to corridors should be 4 changes per hour or enough additional to be sufficient to counterbalance the excess of exhaust from all rooms connected to corridors where there is no air supply or where the supply is less than the exhaust.

Note B—The air supply to a forge room should be not less than 30 c.f.m. per occupant and should be increased to make up any unbalanced condition occurring when the forges are all running each being supplied with 200 c.f.m. air blast and 400 c.f.m. forge exhaust.

VENTILATION.

Number of Air Changes.

The table below shows the changes of air per hour, or the cubic feet per minute (C.F.M.) per occupant, as recommended by the best authorities for various rooms of miscellaneous character as listed below.

ROOM	SUPPLY		EXHAUST	
	C.F.M. Per Occupant	Minimum Air Changes Per Hour	C.F.M. Per Occupant	Minimum Air Changes Per Hour
Assembly and Conventi Halls	30	8	30	8
Boiler Rooms	..	10	..	none
Engine Rooms	..	4 to 6	..	8 to 10
Factories	20 to 30	4	20 to 30	4
Foundries	..	4	..	4
Halls and Assemblies	30	8	30	8
Mill Buildings	20 to 30	4	20 to 30	4
Offices (outside small)	none	..	none	..
Offices (inside small)	..	6	..	6
Offices (large)	20 to30	..	20 to 30	..
Private Office (large)	..	6	..	6
Private Office (small)	..	none	..	none
Public Offices (large)	..	4 to 8	..	4 to 8
Public Offices (inside small)	..	6	..	6
Public Offices (outside small)	..	none	..	none
Public Toilet Rooms	..	none	..	10
Public Waiting Rooms	..	4 to 6	..	4 to 6
Pump Rooms	..	4 to 6	..	8 to 10
Round Houses	..	none	..	12
Toilets	..	4 to 6	..	10
Waiting Rooms	none	..	..	4 to 6

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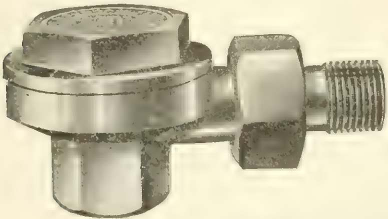

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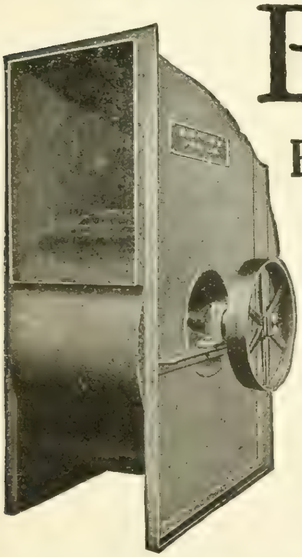

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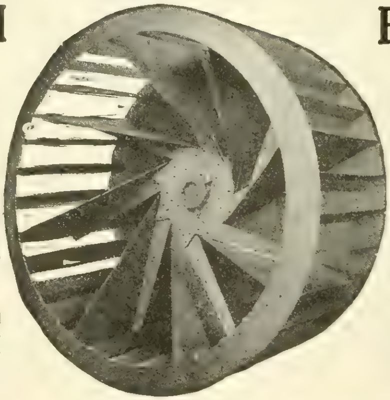

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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. JULY, 1917 1123 Broadway, New York

Schoolhouse Heating and Ventilating in Indiana

Analysis of Existing Conditions, Covering Warm Air Furnace, Steam and Hot Water Systems.

A remarkable presentation of present-day conditions in the design and application of mechanical heating and ventilating systems, with special reference to Indiana, has been prepared by Professor C. B. Veal, professor of mechanical engineering at Purdue University, at the instance of the State Department of Inspection and Supervision of Public Offices. The report is confined to schoolhouse heating and ventilation, but the findings, in many respects, apply to all classes of heating work.

In the first place the report states that a diversity of opinion has existed for several years with respect to the relative merits of the various systems of heating and the ventilation of public school buildings and their compliance with the sanitary schoolhouse law of Indiana. The controversy between manufacturers of heating and ventilating systems and between contractors is renewed practically every time bids are received by township trustees and school boards and has frequently resulted in the elimination of meritorious systems, on the theory that such systems do not comply with the sanitary schoolhouse law. This practice, the report states, restricts competition, fosters monopoly and, in many instances, results in contracts being awarded upon bids that are not the lowest submitted. It encourages collusion, conspiracy and extortion. Arguments made by manufacturers and contractors often confuse officials who are not experienced in heating and ventilating, and contracts are frequently secured for inferior heating systems at exorbitant prices through gross misrepresentation. It would be difficult to estimate the loss sustained by the taxpayers of the state through this corrupt practice.

The object of the department in making an investigation of this important matter was to find the system of heating and ventilating that will meet the requirements of the law, best conserve the public funds and encourage legitimate competition. It was the department's opinion that this question could be solved only by a searching investigation by expert heating and ventilating engineers who were in no way connected with the manufacture of heating and ventilating apparatus, or interested, directly or indirectly, in the heating business.

Professor Veal's investigation and the tests of existing systems were on the basis of the provisions of the sanitary school house law of Indiana, namely: heating, ventilating, humidity, initial cost, durability, up-keep, safety, operating cost and cleanliness. During the investigation, Professor Veal consulted those in charge of the engineering department in some of the largest universities of the United States and gave due consideration to their suggestions. He spent many months in making various tests and in the compilation of his report, which is regarded as the most complete of its kind published in the United States. Its practical use by township, school and other public officials who have charge of the construction of public buildings, including the installation of heating, ventilating and plumbing equipment, will, it is expected, effect a large saving to the taxpayers of Indiana, estimated by expert engineers at more than $100,000 annually.

The report states, in part:

No attempt will be made to formulate definite specifications and rules for procedure in schoolhouse heating and ventilating. Attention will rather be directed to an analysis of the existing situation leading to certain recommendations which, if approved, may form the basis for regulating measures.

Any study of the present question logically divides itself into three considerations, the *available methods,* the *law* and the *demand.* Before a selection of heating methods can be made there must be a clear understanding of the principles of operation and relative adaptability of existing systems to schoolhouse heating. Under the *second* consideration, interpretation must be placed upon the provisions of the existing law, and classification made of available systems in accordance with their qualifications to compete under the law, *i. e.,* "What does the law specify?" and "To what extent can the various systems qualify under the law?"

Under the third head two parallel questions should be considered: "What is demanded in the heating and ventilation of schoolhouses?" and "Which systems will best satisfy these demands?"

After describing the existing systems the report takes up the qualifications of the different systems.

HOT-AIR FURNACE SYSTEMS.

Following are the opinions expressed of warm air furnace systems, and steam and hot water heating systems:

The conventional hot air furnace is little more than a specially designed stove surrounded by a casing and usually installed in the basement of the building to be heated.

Although it may be regarded as the most common method of small residence heating today, as compared with other systems providing ventilation, its only advantage for schoolhouse heating lies in its low first cost. Its disadvantages are those common to the system, in residences or wherever installed, the principle of these lying in the fact that by this means it is very difficult to heat any portion of a building while that particular portion is directly exposed to a strong wind. Another serious objection to the hot-air furnace system is that the ducts are liable to become unsanitary through the collection of dust, and any cracks or leaks in the furnace permit the absorption or entrainment of noxious gases and soot by the incoming air, thus impairing, rather than improving ventilation.

Such a system cannot be recommended for schoolhouse heating except for buildings with not more than four rooms, where economy in first cost is absolutely essential, and then only when the utmost precaution is taken in the design and construction so as to comply with the intent of the law and the requirements of uniform heat and good ventilation.

FORCED CIRCULATION—HOT AIR FURNACE SYSTEMS.

With increased initial, operating and maintenance costs hot air systems, with forced circulation, will be subject to the same disadvantages as the gravity hot air furnace, except for positive circulation of the air to all parts of the building with less regard for the disturbing influence of outside winds. Although not an inherent fault of the system, the type of fan employed in its installation has all too frequently been inefficient and wholly unsuited to the economical propulsion of air under the required conditions of pressure, thus further increasing the cost of operation.

The impact under pressure of the cold air from out of doors against the frequently almost red hot fire-surfaces of the furnace is quite likely to develop cracks and leaks through strains produced by sudden cooling or unequal expansion of the metal, rendering this type of equipment more objectionable than a gravity plant by way of supplying coal gas and the products of combustion along with the supposedly "fresh" air. Evidently the fire hazard of such plants is very great and it is a matter of record that serious fires in public schools have so frequently been traced directly to furnace systems as to render the selection of such a system unwise from the standpoint of common safety. Furthermore, the temperature of the furnace is sometimes very high, and reducing the supply of air at any time tends to increase the furnace temperature, since the air supplies a cooling effect. Such a reduction in the supply of outside air will naturally increase the outgoing temperature of that which is supplied, thus resulting in excessively high temperatures of air entering class rooms. Temperatures as high as 275° F. have been observed by one of the best authorities. Such a temperature is dangerous to the structure of the building and, furthermore, very materially increases the fire hazard. It is unnecessary to call attention to the probable withering dryness of this air, or its harmful, if not positively painful, effect upon pupils subjected to its draught. With even normal temperatures of operation for a fan-blast system it will be found extremely difficult to consistently comply with any proper requirement in humidity, unless elaborate and expensive equipment be installed.

It may thus be seen that hand regulation of temperature and humidity may prove exceedingly troublesome; any attempt to secure automatic temperature and humidity control is sure to prove an expense incommensurate with type of plant, and probably equally unsuccessful, unless made the subject of continuous care by a highly paid expert.

The erection of such a plant is particularly inadvisable where electric current is not available for driving the fan. Inasmuch as no steam is generated in the plant an internal combustion engine,—of a size and type expensive, noisy and uncertain in operation,—represents the only available motive power in such cases. The necessity of having gasoline fuel stored in or about the building constitutes, within itself, an added danger.

Although it is possible to find individual instances where the cost of operation of a fan furnace system has been less than that of a similar steam system, the consensus of opinion, from such records as are available, is that steam or "fan-coil" systems are less expensive to run, while without exception a direct-indirect steam system can be operated more cheaply. Light weight and poor construction of parts of the usual fan-furnace system, together with the development of cracks through great unevenness of temperature, lead to numerous and expensive repairs, often bringing the cost of maintenance above that of any normal allowance for depreciation. Whatever may be the advantage of the fan-furnace system it has been the almost universal experience that where such equipment has been installed it has been removed and replaced by some sort of steam system within a period of ten years, because of unsatisfactory service.

If this system is to be installed it should be with the best modern type of plate, or preferably multi-vane fan; it should have a furnace of ample and properly proportioned grate and heating surface for this particular work; and no contract should be let for such a system in any building without the approval of a competent and disinterested heating and ventilating engineer, and the health authorities.

HOT WATER SYSTEMS.

While the low temperature of radiators, leading to greater transfer of heat through convection than through radiation, and consequently a more natural quality of heat, appears to commend hot water heating for direct radiation in school rooms; on the other hand, its high first cost, even with gravity circulation, lack of positiveness in circulation without pumps, large radiating surface, particularly with indirect arrangement, slowness in "heating up" and liability to breakage in radiators through freezing make hot water unsuitable as a heating medium for schoolhouses, under most circumstances.

Without provision for ventilation in heating, it is quite possible in mild weather to run a hot water system with a very low fire, thus resulting in economy of operation, and securing a reduction in the coal bill which tends to offset the extra first cost of the installation; but during operation at full capacity the cost of fuel probably will be no less than for steam. This latter consideration will apply particularly with an indirect or direct-indirect system and there is little doubt but that the same money, if spent in installing a modern vapor-vacuum steam equipment, would result in just as low total cost per season.

STEAM SYSTEMS.

Heating by steam is made dependable and uniform in operation through positive circulation, without mechanical devices to force it, and in this respect is unquestionably superior to either hot air or hot water. When properly fitted and piped every radiator should be kept hot without trouble. The radiators and piping are smaller than for hot water and there is no danger of freezing even with indirect or direct-indirect radiators.

For heating small and medium sized buildings there have recently come into extensive use various so-called *atmospheric* and *vapor* systems. These are all of a patented character—and as such need not be minutely described here—designed to make use of the principle that water will vaporize, or turn into steam, at a lower temperature if under a partial vacuum. In this respect the vapor systems differ from the vacuum systems employed in large public and office buildings only in the method of producing, and the amount of vacuum carried. As it would not be economical to install an elaborate, motor driven apparatus in a rural or small school building several sufficient, positive and less expensive methods of producing a partial vacuum are offered by various companies. As in the case of *vapor* and *vacuum* systems the distinction between *atmospheric* and *vapor* systems is more one of degree than of kind.

In a flexible type of vapor system the degree of vacuum can be increased in mild weather, thus permitting practically as low fire as with a hot water system. By varying the amount of vacuum the temperature of the vapor or steam in the radiator can be graduated as with hot water, but with this decided advantage: during cold weather the steam can be put under pressure, operating as a plain pressure system, thus requiring no larger pipes and radiators than a normal steam installation. Moreover, the expansion tank of the hot water system is eliminated; air valves are replaced by vapor or vacuum traps at the radiator outlets; and a return pipe to the vacuum-producing apparatus insures good circulation, and makes the process of "heating up" even more rapid than with low pressure steam. At the same time it avoids the attention, leaks and unpleasant odors associated with most air valves. In some of these systems the radiators are equipped with special inlet valves designed to permit easy hand modulation or control of the amount of steam admitted to the radiator, according to demand, thus effecting economy in the use of steam and reducing the pressure in the return pipes. There is no danger of injury where a radiator is exposed to freezing, and, in general, it may be said that, to a remarkable degree, these systems secure the advantages of both hot water and low pressure steam without the disadvantages of either.

Such systems do, however, have disadvantages peculiar to themselves. Primarily, objection to their use is based on liability of trouble arising from complications introduced in connection with the vacuum producing apparatus. Although more economical in design and equally efficient in operation, the prices of the patented specialties bring the first cost of a vapor system up nearly, if not equal, to that of hot water. However, one advantage obtains directly from these patented features, in that the companies controlling them insist on providing or approving plans and specifications where their materials are used, in order that they may safely and intelligently guarantee successful operation. This they do without additional charge; and their experience should go a great way toward insuring a properly designed heating system for a schoolhouse of small or medium size.

For large buildings an approved form of power vacuum system is recommended.

DIRECT SYSTEM.

While a direct radiating steam system overcomes most of the objections to a hot air furnace equipment, in common with any direct system for securing heat, it has little advantage over the stove from a standpoint of ventilation since it affords no means within itself, for providing ventilation. With such a system the open window must be resorted to, and while some still express their convictions that the open window is the sole solution of the question of ventilation, the weight of opinion is clearly against such a practice. In not a single recent important investigation has the open window solution been proposed or supported. The logic of this present tendency must be apparent, since even the most rabid advocates of open window schools admit the need of at least a little heat in the rooms; and with open windows it is not alone a question of housing children in uniformly cold rooms, but one of subjecting them to variations of temperature that may be both sudden and extreme. This, in the opinion of those best qualified to judge, is a condition that will never be allowed to prevail for any length of time, due to the disastrous results which must follow such a course.

If it is agreed that school rooms must be continuously heated, and without any regard to the uniformity of this heat, it appears that there is little excuse for installing direct radiation and placing dependence upon open windows for ventilation, since heating with admission of cold air through windows is most difficult to accomplish and requires considerably more radiating surface than is necessary with the direct-indirect or indirect systems with natural circulation. Neglecting although the increased cost of operation, it appears that the first cost of the extra radiation would be more than that of bases, dampers and diffusers for a direct-indirect system.

Of course, where windows exclusively are depended upon for ventilation the cost of vent ducts is eliminated, but this cost need be very small indeed if ducts are built directly into a new building. The installation of a direct system of radiation can be justified, if at all, only on the ground of enforced economy, and this is of doubtful accomplishment.

DIRECT-INDIRECT SYSTEM.

The application of the direct-indirect system necessitates placing the radiators along an outside wall in order to secure the outside air supply which characterizes the system. No very definite rules have been developed regulating the size of opening and admission of air to the radiators and until recently most inlet devices were too small to admit sufficient air for ventilation of school rooms.

The principal advantages are: comparatively low first cost; a series of separate sources of heat for each room; the air is not necessarily contaminated by admission through the radiator and remains essentially as pure as its outside source; the system is not affected by winds to the same extent as the furnace system with gravity circulation, and for that reason is more efficient, more certain and more easily regulated than a furnace equipment.

With an actual opening to the outside air, such as exists for each radiator with this system, it is evident that the amount of air flowing through the opening will be dependent not only upon the difference in pressure outside and inside, created by the air inside being heated and therefore lighter, but also upon wind pressures. A strong wind blowing against the wall in which these openings are placed will cause more air to flow into the room, while a wind in the opposite direction will decrease the inflow and under exceptional conditions may even cause a temporary reversal of flow, the heated air passing from the inside outward. This state of affairs can be regulated only by judicious use of hand control.

Aside from the disturbance caused by wind which can be partially, if not wholly, remedied by regulation of dampers, the most serious difficulty with such a system arises from the fact that in calm weather it is the heating effect of the radiator which causes air to flow into the room, the amount passing in depending upon the temperature of the radiator and increasing with that temperature. Sufficient radiating surface must be installed to heat the room in coldest weather, while still admitting sufficient air changes. Some claim that this cannot be done, but if it can, it means an extraordinary amount of radiation in mild weather, and in such weather, to prevent excessive room temperatures, use must be made of some "modulating" inlet device on the radiator to reduce its temperature or part of the radiation must be shut off, either one of which will decrease the flow of air from outside, except under favorable circumstances, and may result in too few air changes per hour. A well-designed and properly-installed ventilating cowl and aspirating foul air vent flue, by their activity in tending to produce a vacuum in the room, will go far toward correcting this trouble and by intelligent use of open windows, as a supplementary scheme, may result in most satisfactory ventilation in the mildest weather for which artificial heat is required.

The importance of the vent flues, in securing ventilation, readily will be seen when it is considered that air cannot continuously be drawn into a room unless air is taken out. Heating coils placed in a vertical duct heat the air, thus causing it to rise because of its lighter weight. As this heated air in rising passes directly to the roof, all the heat used in accelerating circulation is lost so far as heating is concerned. This fact renders the aspirating coil a most inefficient scheme for moving air. Where electric current is available it should be much cheaper to lead all vent flues to a motor driven exhaust fan, located just under the roof.

In years past there has been some doubt as to the ability of this system to provide proper moisture for the air after being heated, but recently there has been developed a number of "moisteners" for attachment to the radiators or to the diffusers which are now universally provided to effectually prevent drafts.

The initial cost of the average direct-indirect steam system will probably be more than that of any of the systems previously discussed, but for almost any class of school buildings it should prove more satisfactory than any of them. Such systems are comparatively safe, economical and durable.

INDIRECT SYSTEMS.

The natural air circulation system operates on the same principle as the direct-indirect, and differs in construction only in that the radiators, which are of a special type developed for this use, are placed outside, usually beneath the room, and the cold air from outside is led through ducts to the radiating surface and then rises to the rooms through other flues or ducts. Perhaps its only important advantage over the direct-indirect is that the heated air can be admitted to the rooms at any desired height above the floor or from any wall or floor surface. The additional ducts required make the expense of installation considerably higher than that of the direct-indirect.

FORCED CIRCULATION.

Indirect heating systems with forced circulation are variously known as hot blast heating, plenum, fan blast, fan coil or mechanical warm air systems. These are but different names for what is essentially the same thing and in them all we find a blower or fan added to the usual complement of equipment in an indirect gravity system. Whatever advantages may be ascribed to the systems previously described (the fan-furnace possibly excepted), all are deficient in supplying the positive ventilation assured where the blower is added. No system of natural circulation can give absolute assurance of adequate ventilation in an auditorium or in any room occupied by a large number of people.

Many devices in the way of attachments and auxiliaries have been developed to perfect the results obtained with this system. These auxiliaries include air washers, humidifiers, cooling coils, and automatic thermostatic and humidity control equipment. Where proper air washers or purifiers are operated in connection with this system, it has been found possible to recirculate air from the building, rather than take it from outside, and still obtain perfectly satisfactory ventilation. The quality of this recirculated and washed air is superior to that often obtained from outside where dust and dirt may abound in the source of supply, as in the case where the inlet is taken from a crowded city street. The practice of recirculation will frequently reduce the cost of coal from 30 to 50% but where the source of supply is outside the cost of fuel must necessarily be high. Electric power for driving the blower is desirable, but a low-pressure steam engine operating from the system's own boiler may be employed. Wherever basement rooms are used as school rooms, some form of fan circulation is necessary, if ventilation is to be positively secured, and in such buildings, of medium or large size, it is recommended that a fan coil system be installed where the original cost and operating cost are not prohibitive.

As sometimes designed, the use of automatic temperature control devices makes closed windows a necessity since the opening of windows in one room and the attendant drop in temperature will produce overheating in another room, and while a real source of trouble in some buildings, it is evidence of a defect in design rather than in principle. The regulation of humidity, where humidifiers are used, is a matter which must receive almost continuous intelligent attention. Thermostats likewise require frequent expert attention, if they are to be kept in working order.

The real source of trouble with the forced circulation system of heating and ventilation arises through ignorance and lack of instruction of caretakers and teachers. With co-operation between teachers and plant operators, and intelligent supervision, this system must eventually prove superior to all others, but its installation is useless, and cannot be recommended, unless the school authorities are willing to pay a price for attendance commensurate with the high quality and first cost of equipment and the excellent results attending its skillful operation.

COMBINATION OR SPLIT SYSTEM.

The forced ventilating and heating system is sometimes varied by heating the rooms with direct radiation and supplying ventilating air at room temperature with a fan and tempering coils. This arrangement results in fuel economy to the extent that only the air furnished for ventilation need be heated. At times, when no ventilation is necessary, the fans and fan-coils may be shut down. Such a system will prove more expensive to install but is very generally regarded as an improvement over the full plenum system.

PROVISIONS OF THE LAW.

In analyzing the provisions of law, those provisions which, by their own specific statement, apply to but one type of heating, and those which unquestionably can be met by every form of heating, are omitted as having no bearing on the present questions. Neither is any attention given to those regulations which apply only to systems for use in old or temporary buildings.

Following are the principal provisions of the Indiana law:

a. Fresh air shall be taken from outside the building.

b. Fresh air taken from outside shall be properly diffused without draughts through each school room during school session.

c. Each school room shall be supplied with foul air flues.

d. Foul air flues supplied shall be of ample size to withdraw the foul air from each room at a minimum rate of 1800 cu. ft. per hour for each 225 cu. ft. of said school room space, regardless of outside atmospheric conditions.

e. Heaters of all kinds shall be capable of maintaining a temperature of 70° F. in all school rooms, halls, office rooms, laboratories and manual training rooms in all kinds of weather.

f. Heaters of all kinds shall be capable of maintaining a relative humidity of not less than 40%.

COMPARATIVE COMPLIANCE WITH THE LAW.

In the following table, showing the relative capability of the various systems to meet the requirements, the numbers in the first column of the table refer to the provisions of the law given above under the same number. The indications of the letters are as follows:

A. Full compliance.
B. Fair compliance.
C. Poor compliance.
D. Failure to comply.

The analysis is purely arbitrary and is based on the performance to be expected, with reasonable care, in normal operation in all kinds of weather.

NOTE: In systems where the fresh air taken from the outside serves the double purpose of ventilating and heat-carrying medium, the provision requiring *proper diffusion without draughts* is interpreted, in the following tabulation, to include distribution of heat in room.

The short-comings of the two direct systems are considered so great as not to warrant their serious consideration. A study of the various columns will indicate an increasing qualification from left to right. The requirements emphasized by the law are such as to permit a better showing by the direct-indirect heater and the furnaces than would actually be found in practice. No requirements are made for many of the points of operation in which these devices are most faulty. In so far as the provision of the statutes are concerned the direct-indirect radiator system is just as satisfactory as the indirect radiator system with gravity circulation. The fan-furnace equipment complies only fairly with the second and sixth provisions of the law.

The demands as to heat, ventilation, temperature, cleanliness, movement, and humidity are then discussed at length in the report, followed by a section on costs, including initial and maintenance costs and operating costs.

regarded as an accurate measure of the air supply and distribution in such rooms. For this reason it is recommended by no less authority than the American Society of Heating and Ventilating Engineers that a carbon dioxide test of proper supply and distribution be applied; yet, no such provision is made by the law.

RELATIVE CAPABILITY OF SYSTEM TO MEET REQUIREMENTS.

Provisions	Direct Systems		Direct-Indirect Systems		Indirect System Natural Circulation		Indirect System Forced Circulation	
Law	Stoves	Radiators	Heater	Radiator	Furnace	Radiator	Furnace	Coil
1	C	C	B	B	B	B	A	A
2	D	D	C	B	C	B	B—	A
3	A	A	A	A	A	A	A	A
4	C+	C+	A	A	A	A	A	A
5	A	A	A	A	A	A	A	A
6	C	C—	B	B	B	B	B	A

The various systems are then classified according to the type of building.

CONCLUSIONS.

1. While the law requires a heating capacity sufficient to maintain an indoor temperature of 70° F. in all kinds of weather, it does not specify any maximum temperature limits; and this condition exists in spite of the fact that the injurious effects of overheating constitute the only undebated issue regarding ventilation.

2. No provision is made as to the point, or number of points, at which room temperature shall be observed during school hours. Thus, no specific plan is laid down for ascertaining that the temperatures are proper and uniform throughout the room.

3. It is compulsory that air be taken from outside, but no provision is made against the use of air containing excessive dust particles or other impurities.

4. While carbon dioxide in the air in quantities likely to occur in a school room, cannot be considered injurious to health, its presence in occupied rooms .

5. While the excellent qualities of the fan-coil system are recognized, it is readily admitted that conditions are not such as to warrant its use in all cases. Many times its cost renders it entirely prohibitive. In such cases the direct-indirect system offers the best substitute, considering both cost and results, since this system yields results practically equal to those obtained with the gravity indirect and, in general, possesses more commendable features than any other, excepting only the fan-coil system.

6. Evidence is lacking to show that as a permanent equipment for schoolhouse heating and ventilating, a well designed and constructed system of a theoretically poorer type will render better satisfaction than a poorly constructed, cheap system of a theoretically better type. Furthermore, a mediocre type of apparatus, when given careful, intelligent attention, will yield more satisfactory results than can be attained with the finest system in the hands of an ignorant and inexperienced operator.

7. Finally, selection of all equipment and attendants should be made with the idea of safeguarding the expenditure of

public money and the loss of property, and, more especially, the health and lives of school children.

The findings of the report have received the endorsement of a number of prominent engineers, including Professor J. D. Hoffman, of the University of Nebraska; Professor John R. Allen, of the University of Michigan; Professor A. C. Willard, of the Illinois State University; S. A. Challman, commissioner of school buildings of the University of Minnesota; Professor J. L. Mowry, of the University of Minnesota; and Professor Frank C. Wagner, of the Rose Polytechnic Institute.

Radiation Requirements under Varying Temperature Conditions

With Chart Giving Graphic Solutions for Use in Weather Above and Below Zero.

By EDWARD B. JOHNSON, C.E.

There are a number of preliminary considerations which present themselves when undertaking the design of a steam heating system and among them none is more important than the relation of outdoor and indoor temperatures and the amount of radiation installed. When so-called standard conditions are to be met, 70° F. room temperature with zero weather outdoors, no difficulty will be experienced and this covers the majority of cases. But when either one of both of these temperature limits are varied, we are liable to get into difficulties.

Varying the lower limit only should cause little trouble if it be remembered that in this case the amount of radiation is proportional to the temperature rise desired. Thus, assuming 0° to 70° F. as requiring 100% of radiation, 20° to 70° would require 71.4%.:

$$\frac{70 - 20}{70 - 0} = \frac{50}{70} = 71.4\%.$$

And for — 30° we would require 143%:

$$\frac{70 - (-30)}{70 - 0} = \frac{100}{70} = 143\%.$$

That is, if the radiation has been computed for standard conditions and it is desired to alter our computations in order to satisfy the altered outdoor temperature of — 30°, simply multiply by 1.43 the radiation for each room and the desired result is obtained.

But when the upper limit (room temperature) is varied, we immediately add to the problem the variable factor of radiator efficiency, due to the changing temperature of the air surrounding the radiating surface. The term efficiency, as here used, refers to the variation in the amount of heat radiated to the surrounding air from the heated surface as the room temperature varies. This amount is approximately proportional to the difference in temperature between the steam (or hot water) in the radiator and the room.

Table 1, Column 2 gives these amounts for every 5°. Column 3 gives the pounds of steam condensed per hour, and Column 4, the relative tax on the boiler. This table shows that a radiator standing in, say, 50° still air produces a tax on the boiler equal to about 18% more than it would had the surrounding air been at 70°, a very important fact, as extra boiler capacity to this amount should here be provided.

Assuming that each square foot of radiation standing in still air at 70° condenses ¼ lb. of steam per hour and steam at 220° F., this would equal 965 ÷ 4 = 241 B.T.U. per hour. This is generally taken as 240 B.T.U.

The difference between the room and steam is 220° — 70° = 150° and the

B.T.U. radiated per square foot per degree difference of temperature is $240 \div 150 = 1.60$. This is called the heat emission factor.

C. A. Fuller, in his article on "Heat From Radiators at Different Temperatures," (THE HEATING AND VENTILATING MAGAZINE for March, 1915), states that this heat emission factor is not absolutely a constant, but varies with the temperature difference between the steam and the room, increasing as the difference increases and, of course, diminishing with a smaller difference by an amount equal to 1/5% for every degree above or under 150° difference.

Consider these conditions: Steam 240° F., room temperature 50° F. $240 - 50 = 190°$. This is 40° in excess of 150° difference. $40 \times 1/5 = 8\%$. As 190° is greater than 150° standard difference, 8% is to be added to 1.6, making the heat emission factor, under these circumstances, 1.73.

Then $1.73 \times 190 = 329$ B.T.U., the heat transmission per square foot of heating surface per hour under the above conditions. Considerable difference, as compared with 240 B.T.U. for standard conditions.

The third condition mentioned, when room and outdoor temperatures are both varied, will not be considered here, as it is taken up later.

All of this is very fine for the mathematically-inclined, but most engineers prefer to arrive at results with the minimum of figures, thus saving time and tending to eliminate possible errors. Therefore, a table or curve which will give the result graphically of a complicated problem is almost universally acceptable.

Fig. 1 has been drawn to assist in the easy solution of the above problems and probably of others which the reader may discover.

Let us consider the first case previously discussed, when the outside temperature is varied. Upon the right side of the curve will be found outdoor temperatures from—30° to 40° F. At the top are room temperatures from 40° to 130°. The curves represent varying percentages of radiation installed, the 100% curve indicating conditions when the correct amount is installed to heat the room to 70° in zero weather, as will be seen by its passing through the intersection of these temperatures. The 80% curve then would indicate the relation of outdoor and room temperatures when 80% of the correct radiation has been installed.

To answer our problem find the desired outdoor temperature at the right and follow this horizontal line to its intersection with the 70° vertical line

TABLE I—STEAM RADIATORS—HEAT TRANSMISSION PER SQUARE FOOT SURFACE WITH STEAM AT 220° F.

Room Temperature—Deg. F.	B.T.U. Per Hour	Pounds of Steam Condensed Per Hour.	Relative Boiler Tax.
130	127	0.132	52.6
125	135	0.141	56.2
120	144	0.150	60.0
115	153	0.159	63.8
110	162	0.169	67.5
105	171	0.178	71.2
100	180	0.188	75.0
95	190	0.198	79.2
90	200	0.208	83.3
85	210	0.218	87.5
80	220	0.229	91.7
75	230	0.240	95.8
70	240	0.250	100.0
65	250	0.260	104.2
60	261	0.272	108.8
55	272	0.283	113.3
50	283	0.295	117.9
45	294	0.306	122.5
40	305	0.318	127.1

(room temperature) and the desired percentage is read off upon the intersecting curve.

Assume that the amount of radiation is desired to heat a room to 70° during —20° weather. Following the above directions, we read off 128%.

If the room temperature varies: by picking out the desired room temperature at the top of the curve and finding its intersection with the zero line (outdoor temperature) the percentage of radiation required is readily read off. For example, 40° room temperature and zero outdoors. The 40° vertical and zero horizontal line intersect at a reading of 45%. If 500 sq. ft. were needed for the room under standard conditions.

$$500 \times \frac{45}{100} = 225 \text{ sq. ft. would be}$$

needed, under the above conditions.

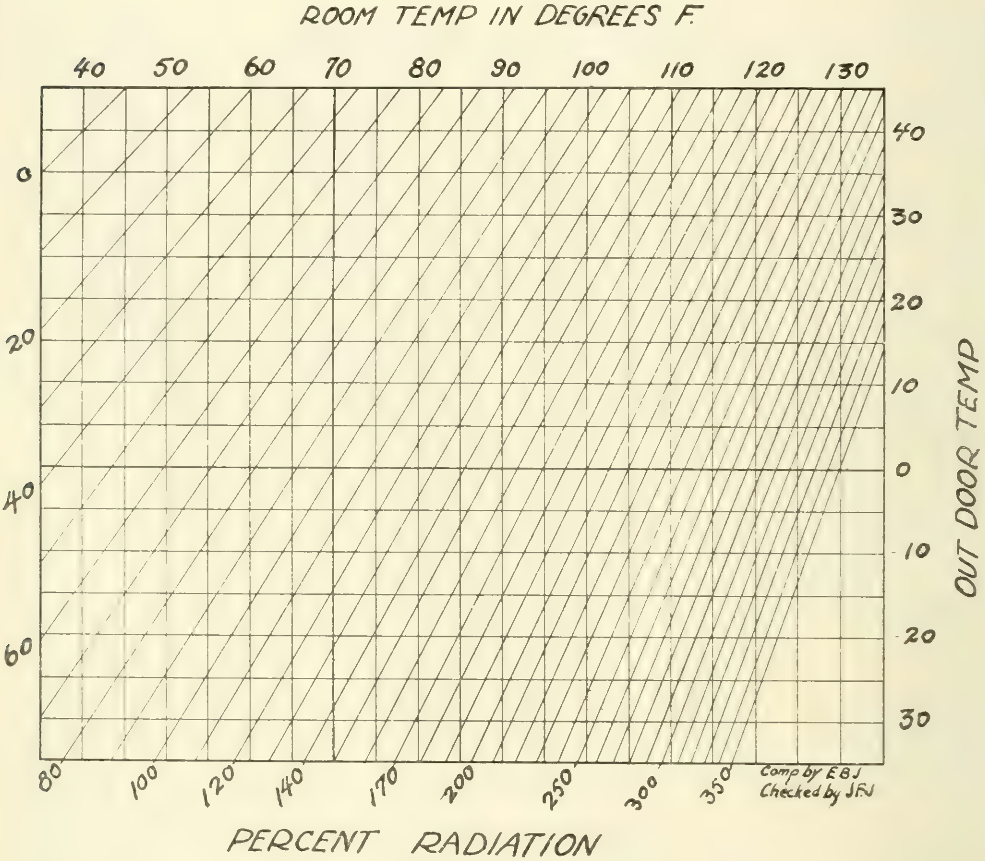


FIG. 1.—CHART FOR FIGURING RADIATION REQUIREMENTS WITH VARYING OUTDOOR AND INDOOR TEMPERATURES.

In the same way, when both limits vary, find the intersection of the required room and outdoor temperatures and the required percentage of radiation is read off directly. Thus, 90° room temperature and — 15° outdoor temperature intersect at 180%.

Now suppose an owner is having sufficient radiation installed to meet standard conditions, but there is a possibility of the thermometer dropping to — 20°, to take an extreme case. He would like to know what temperature he could probably maintain in the rooms. Follow the 100% curve down to its intersection with the horizontal — 20° line. Read the corresponding room temperature at top. The owner could, therefore, heat the house to 58°.

We will suppose, also, that the job is completed and we would like to know whether the building could actually be heated to 70° in zero weather. Heat the building until the room temperature has become stationary. Read the indoor and outdoor temperatures, find their intersection on the curve, as described. Follow the curve to its intersection with the horizontal zero line and read the corresponding room temperature at the top. If 70° or more, all is well, but if less than 70°, the radiation is probably insufficient.

In making use of the table and chart, it should be noted that they are for steam heating calculations only.

The Transmission of Steam Heat from Central Plants

By W. H. PEARCE, M.E.

The history of steam transmission is so interwoven with the history of the steam engine that in order to convey a general idea of the circumstances and conditions under which the art has advanced, a review of one necessarily involves a review of the other. A man who recently received his university diploma stated that "the greatest advance in steam engineering has been made during the last ten years and that those who had not had the advantage of a thorough training in recent practice were behind the times." Nowadays, general public opinion appears to consider the achievements of such men as Newton, Watt, Hornblower, Newcomen, Papin, Murdock and Threventhick as mere incidents of a past age and that American genius, especially that of the present time, has accomplished a large part of all that is of value in the art; therefore a review of some of the prominent facts of history may be briefly set forth.

Without giving consideration to the early steam devices it is conceded by the best engineers that the real discovery of the force of steam was when scientific investigation was made to determine why a certain tea-kettle lifted its lid when the spout was plugged, and the means undertaken to make that force serve mankind. The tea-kettle was the first boiler, the spout the first transmission pipe, the plug the first valve and the lid was the first pressure indicator. These four elementary essentials always are found in every steam plant.

The greatest credit for discovery and advancement in steam engineering should be given to Watt, a Scotch scientist and instrument maker, who associated himself with Boulton, a capitalist. They constructed the large foundaries and shops, commonly known as the Soho Works, at Birmingham, England, where, long before some of our inventors saw the light of day, great engines and steam plants were planned, contracted for and constructed. Associated with these works and contributing to its many achievements were other distinguished men of the times, so that the history of "Soho" is largely a history of steam engineering.

One hundred and forty years ago Watt, with his acquired genius, qualified the various conditions of steam, gave us the steam-engine indicator, and the condenser. He adapted and used the poppet valve which is now considered one of the last achievements in American engine building. The Soho Works later advanced so far in the art that one of their engines was operating a few years ago on 12 lbs. of water per horse power which bears favorable comparison with the best practice of today.

It is also well to remember that the building of steam engines developed the tools for the shop;—the slide rest took the place of the hand tool;—the planer took the place of the hammer and chisel. The first iron planer bed had its ways chipped and filed to true alignment by the hammer and chisel process which may indicate to those accustomed to modern appliances the mechanical skill of the workmen of one hundred years ago.

Not only was steam transmitted to auxiliary engines and for other general uses but also the transmission of hydraulic power was given attention. It has since been brought to such a degree of usefulness, especially in high-pressure work that some of our engineers might advantageously review their efforts on which so much money has been spent.

Murdock having knowledge of the value of coals and the transmission of steam saw greater profits in the extraction of gas from coal and selling it as an illuminant. This he accomplished after first convincing the credulous laymen of its possibilities, by illuminating his own house, thereby opening up the gas industry and the manufacture of many commodities from its by-products.

In general terms it may be said that for many years Americans were not advanced in steam engineering practice to as great an extent as their European cousins. Not that they lacked ingenuity, but the conditions did not warrant its study. There was no need of a compound locomotive since our eastern railroads then ran through a wooded country where cord wood could be had for the chopping. Our boats stopped to "wood-up" at any convenient landing. The cumbersom slide-valve engine and wood-burning boiler, carrying 40 lbs. of steam, served our purpose, while we busied ourselves in producing the best axes, buck-saws, mowers and other tools suitable to our agricultural requirements. As our workshops and population gradually extended westward, New England began to use anthracite coal and such States as Ohio, Indiana and Illinois became dependent upon the coal underlying their lands. Then, as the question of greater steam economy became a matter of interest, George Corliss designed and produced his four-valve engine which has become known and reproduced, with modifications, by almost every engineer in the land.

CENTRAL HEATING SYSTEMS KNOWN A CENTURY AGO.

It is not necessary to call to the minds of old mechanics that our shops were steam heated from central plants, and that steam was transmitted in pipes, either incased in brick or wooden boxes, to the various buildings for use in steam appliances, such as steam hammers, auxiliary engines, etc. Therefore, the idea that we are pioneers in steam transmission is an error, as the boiler, the pipe, valve and gage have always been inseparable. The numerous records in the Patent Office clearly indicate that the practice of transmitting steam is old, from the fact that patentees, prior to the year 1800, illustrated this art and asked for patents on devices and fittings which were to be applied to heat transmission pipes and heating systems.

About the year 1878 Prall, a steam engineer of Washington, D. C., proposed a system of district heating in which the novel feature consisted in transmitting high-pressure hot water to the buildings where it was to be expanded into steam at the radiators. The condensate was released by a thermostatic trap connected with a return pipe to the pump at the power house, substantially like many installations of to-day. A description of this system may be obtained from Mr. Prall's patent of October 1, 1878 and re-issued April 17, 1888.

Holly, a contractor for town and village water-works plants, undertook to transmit steam underground for the purpose of keeping hydrants from freezing, to remove snow from the streets, to keep the boilers of a steam engine ready for duty and to run engines in workshops. He proposed to maintain a pressure of 40 lbs., the steam to be exhausted at 20 lbs. into a secondary main and carried thence to other buildings for drying and heating purposes. Should the pressure in the secondary main become more or less than 20 lbs., the difference was to be made up by means of an equalizing valve mechanism. A more detailed description of this system may be found in patents granted to Mr.

Birdsill Holly, July 17, 1877, and June 27, 1882.

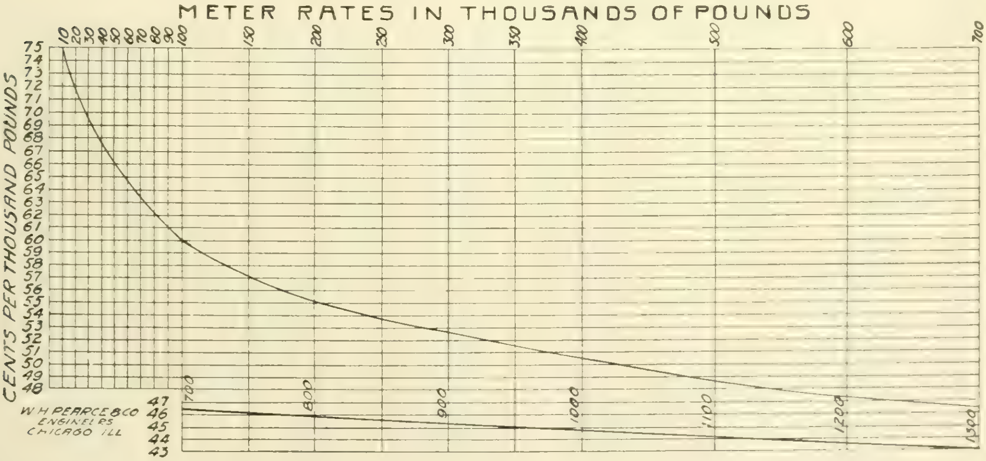
The failures of some of the first district heating plants created such an impression on investors that for many years what is now being recognized as a practical art received but comparatively meager consideration. However, numerous plants have since been installed and the industry has been revived to the extent that a large number of our cities now have commercial central heating plants, and while, in some cases, it is frankly admitted by the managers that the plants are not profitable, others have made such improvements and adapted such devices as to point to permanent success.

In connection with the failures referred to, a number of commercial plants have been erected without sufficient knowledge of the art. Speculation also has done and is still doing its share to offset the skill of the special engineering talent necessary, by constructing cheap plants rather than those of durable character.

Space does not permit of a full description of the various devices now being adapted in district heating work, but among them none is of greater importance than the perfected meter which weighs and registers the amount of steam used by the consumer. In this connection the accompanying chart has been compiled by the writer containing a scale of rates which have been widely approved as furnishing an equitable basis of charging for steam heat service.

The perfecting of steam and condensation meters, together with apparatus used for cooking, providing hot water for domestic purposes, means of heat control, etc., have placed the art on a profitable basis in providing means for utilizing all the heat units delivered to the customer. Hence 1,000 lbs. of steam may be delivered at a fixed cost and its sale guaranteed by an attractive price, while a good margin of profit is left to the investor.

One of our leading scientists made the prophecy a few years ago that "the time will soon come when the great soft coal deposits underlying our Middle Western States would have to be scientifically employed by municipalities for power and heating purposes, from central plants." Judging from the present prices of hard coal at $10.00 a ton, it would seem that the time he referred to has arrived.



SCALE OF METER RATES FOR STEAM THAT WILL GIVE EQUITABLE RESULTS.
(Based on Coal Prices Prevailing Previous to the Present War.)

THE HEATING AND VENTILATING MAGAZINE
A Monthly Journal of Engineering Progress

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IT IS seldom that the value of a trade convention has been so strikingly manifested as was the case in the recent meeting of the central station heating engineers. Within recent months the district heating industry has been placed in a most critical situation and one calling for immediate action. Coal, the principal commodity, which all along had been thought to be fairly fixed as to price, has soared to unheard-of heights, with no assurance that future deliveries could be relied on at any figure within reason. A raise in heating rates was the obvious answer, but the travails of such an effort, not only with the utility commissions, but with the consumers, was a thing that made more than one company hesitate. It is a matter of fact that, at the opening of the convention, there was a marked uncertainty on the part of the members generally as to whether they should re-open the rate situation or postpone action in the hope of a return to normal conditions in the coal trade.

Not only that, but the companies were equally uncertain as to whether they should not lay in their coal supply, even at present prices, for fear of a shortage next fall. Last winter's experience had brought home this danger to them all, and there was at first considerable sentiment in favor of such action, in spite of the almost ruinous prices prevailing.

Long before the discussions had been concluded, it was plain that the sentiment of the convention had been crystallized and that there was more than substantial agreement, first, that rates must be raised, based upon the higher cost of all the principal items involved, and, second, that coal purchases for the winter supply should be held in abeyance. On the latter subject, convincing evidence was presented of wholesale manipulation of coal prices which left no room for doubt that the bubble could and would be pricked.

It is possible the companies would have reached this decision in any event, but it is certain that the meeting and exchange of views brought the matter to an immediate issue and to a settlement that was practically unanimous.

◆

HOW rapidly the movement for compulsory ventilation is advancing may be seen from the codes that have gone into effect since 1914, when the laws covering public buildings generally were reviewed in these columns. Since that time the Illinois school law has become effective, the Minnesota rules have been entirely rewritten and amplified, the New Jersey "Stokes" law has been supplanted with more detailed requirements and, finally the Vermont regulations have been entirely revised and extended to cover picture theatres. Measured by results, the advance has been altogether gratifying.

NATIONAL DISTRICT HEATING ASSOCIATION

Ninth Annual Convention, Detroit, Mich., June 12-15, 1917

"Raise your rates," with no two ways about it, was the slogan of the National District Heating Association at its ninth annual convention in Detroit, Mich., June 12-15. The seriousness of the coal situation was brought home to the member companies with the greatest of emphasis and, while substantial and early relief was predicted in connection with the coal supply, yet it is beyond question that the quotations for coal for a long time to come will be above those on which most of the heating rates are based. This factor, taken in conjunction with the higher costs of labor and materials, will make a raise in heating rates imperative, if the central heating industry is to continue as a profitable industry.

If ever the holding of a convention at a critical time was justified, certainly this one, which awoke the members to the seriousness of the rate question, was justified on that score alone. Many of the members, it developed, were uncertain as to their action until hearing the

THE COAL RESOLUTION

Whereas, The excessive and exorbitant prices now being asked for coal is causing loss and hardship in our country; and

Whereas, Heating is the most essential of the comforts and necessities of humanity;

This Association does hereby ask that the government of the country and its officers and committees take such steps as will compel the great coal industry to market its product at such prices as will give a fair and reasonable return upon the cost of production and at the same time will not injure nor destroy legitimate business in our country;

And that the great transportation companies be urged to arrange to deliver coal as a preferred commodity;

And that we further urge that all associations and utilities assist the government and its officials in bringing about such adjustment of prices for fuel as will be equitable to all parties concerned.

THE RATE RESOLUTION

Whereas, The high cost of operation covering all branches of the heating industry has seriously affected that industry; and

Whereas, In order that the industry may live, it is necessary that such steps be taken as will take care of the present costs in the industry; therefore be it

Resolved, That the association offer its services and pledge its support to any heating utility that desires to legally increase its rates to such point as will afford a fair and reasonable return upon the property used and useful in the business; be it further

Resolved, That we urge all heating companies to take the necessary legal steps before their several courts and commissions as will permit such prices as will give such return.

reports presented in convention and it is safe to say that none went away without a realization of the necessity and urgency of the proposed step. The accompanying resolutions show how this and the fuel questions were handled, the association pledging its services in helping the companies to supplement its present rate schedules.

Morning Session, June 12.

Delightful summer weather ushered in the opening session which was held on the twelfth floor of the Hotel Pontchartrain. Mayor Oscar B. Marx, of Detroit welcomed the delegates in person, the response being made by George W. Martin, first vice-president of the association.

The report of the executive committee was presented by Secretary D. L. Gaskill. It was recommended that all members in the service of their country have their dues remitted. This recommendation was adopted. Some twenty candidates were elected, including a large representation from New York.

PRESIDENT'S ADDRESS.

President Byron T. Gifford, in his address paid a warm tribute to the work of the standing committees and urged a greater use of the columns of the Association's Bulletin in the accomplishment of their work. He bespoke greater efforts on the part of the members in increasing the ranks of the association, declaring that there should be at least 600 active and associate members instead of the 400 now on the rolls.

There is an impression abroad in many quarters, declared President Gifford, that the central station heating industry is not getting proper returns; in short, that central heating does not pay. As one investment banker declared when approached in connection with a district heating proposition, "we are exerting our efforts along other lines."

"Our duty, it seems to me," said President Gifford, "is to show the investing public that money can be made out of heating plants, and we cannot expect money to come to us until we can show good net returns. The longer the present impression exists the more difficult it will be to change this impression, but if we can change it and show the proper value of our business as a place for safe investment, money will come to us and the entire complexion of our business will be changed.

"If your heating plant does not pay proper returns, first get a complete statement of what it is doing and then look for the cause of your trouble. This cause can be in only three places: 1, low rates; 2, high fixed charges; 3, bad operating conditions.

"Examine carefully the operating conditions. There are very few members of our Association who do not know how to put these things right.

"Next examine carefully your fixed charges. It is true that it is very difficult to reduce fixed charges but it can be done. Why not increase the capacity of your equipment and do more business by arranging to increase your boiler capacity with improved stokers, a water-softening plant, forced draft, or by rearranging the baffles in your boiler? If your pipe line is small, why not increase the pressure on the line? Why not send out steam at 20 lbs. instead of 3 or 5 lbs.? Is there any good reason why 5 lbs. back pressure is your limit or is the most economical operating point?

ADVANTAGES OF EXHAUST STEAM OVERESTIMATED.

"This brings us to a very interesting feature of our business. Why not sell high pressure steam? If you are receiving the proper price per unit for your service you are making some profit on each unit, provided, of course, your overhead expenses or fixed charges are not eating up this profit. If you are receiving the proper price per unit, why not sell twice the number of units with practically no increase in fixed charges? You are certainly reducing your overhead expenses in this way. But you may say, 'How about the exhaust steam? We cannot use exhaust steam if we sell high pressure steam.' I will answer that by saying that you do not need exhaust steam. In many cases the amount of money that you make out of the combination operation is nothing compared with the saving you could make by reducing your fixed charges. In other words, the advantages of exhaust steam have, in my opinion, been overestimated.

GEORGE W. MARTIN, NEW YORK
President National District Heating Association.

There are cases where the increase of business cannot be obtained due to local conditions and where the pipe line is already built and the investment made. In that case the by-product with the sale of exhaust steam is probably the best solution of a rather bad situation. There may be some cases where none of the above suggestions will help. In that event examine carefully your rates.

"But such consumers as hotels, cafés, laundries, barber shops, Turkish bath rooms, hospitals, etc., in other words, consumers needing high-temperature steam cannot be served as well by any other system.

"There may be some cases where none of the above suggestions will help. In that event examine carefully your rates.

"If you can teach your consumer to practice economy in the use of heat you will have no trouble increasing his rate per unit. If he is not economical in the use of heat, it is as much your fault as his. He can afford to pay you a living rate if he practices the proper economies. Central heating is fundamentally sound and it is economically sound.

"I appreciate fully that it is no simple step from a financially unprofitable heating plant to one earning dividends. It is not a simple matter but it is certainly a possible one. There are some plants and systems that would probably never pay and in that case the blame should probably be put upon the original builders, yet they were doing what they thought was right at that time. What should be done in a case of this kind is to build a new plant along the right line and take a cold bath as far as the present plant is concerned. If a plant is actually losing money, there is no sane reason why its operation should be continued. It will probably be difficult to interest any one, with a plant of this kind, to make additional expenditures but, as a matter of fact, it is either that or lose what they have already.

"It is my opinion that the heating business must stand on its own foundation and that we must not expect it to be maintained as a by-product to the electrical plants, although a heating plant will materially increase the field of the electric plant.

APPOINTMENT OF "ADVANCEMENT COMMITTEE" URGED.

"My suggestion to you is to appoint a committee to be known as the 'Advancement Committee,' this committee to study carefully the operation of existing plants with the view to learning just what is needed to put our heating plants on the proper basis.

"Let the personnel of this committee be such as to inspire confidence and to insure hard and conscientious work.

"Hot water central heating plants have operated successfully and I believe can be made to be more successful with a few developments and improvements. The one crying need of this branch of our business is a suitable consumer's meter."

SECRETARY-TREASURER'S REPORT.

The report of Secretary-Treasurer D. L. Gaskill showed receipts for the year, including the $311.14 balance left over from last year, of $6,391.68. The total expenses were $6,439.34, leaving a small deficit of $47.66. The accounts receivable, however, amounted to $1,143.75.

The total membership is now 387 showing a gain over last year of 31 members.

President Gifford appointed the following as a nominating committee: A. C. Rogers, chairman; H. A. Austin and A. W. Higgins.

The session concluded with the consideration of a number of proposed amendments to the constitution, all of which were adopted unanimously. The amendments related to the election of members by the executive committee, instead of by the convention; to the dues which were readjusted, and to details regarding the election of officers.

Afternoon Session, June 12.

The first speaker at the afternoon session was Professor John R. Allen of the University of Michigan who delivered a most interesting address on "The Fundamental Laws of Heating."

In discussing Prof. Allen's address it was brought out that the load factor is an important element in connection with continuous and intermittent heating. If a large amount of steam is to be used in the morning for warming up purposes, continuous heating would prove more expensive to a central station heating company on account of the low load factor for lighting at that part of the day.

J. C. Hornung advocated the lowering of the indoor temperature during the night to 55°. With this arrangement the savings for continuous heating will run from 20 per cent to 30 per cent. In closing the discussion, Professor Allen approved of this practice.

In response to a question as to recent experiments conducted by Professor Allen regarding the "best" location for a radiator in a room, Professor Allen stated that with the use of an electrical unit to supply heat to the radiator it had been possible to measure the heat transmission in watts. These later tests, he said, which have been conducted during the past winter, have made it appear that the radiator is, after all, more efficient when placed under the windows. Previous experiments, reported at last summer's meeting of the heating engineers' society, had shown that at a point near the inside wall the radiator had shown the greatest efficiency.

President Gifford took this occasion to mention the plans for closer co-operation between the American Society of Heating and Ventilating Engineers and the National District Heating Association. These, he said, included joint committee work and possibly a joint meeting of the two organizations.

REPORT ON STATION OPERATION.

The report of the station operating committee which was then presented, was a lengthy document compiled by a committee headed by Jay Grant DeRemer, chairman. The topics covered included feed water treatment, furnace design and insulation of boiler walls, bonus systems in the boiler room together with a discussion of methods for determining the best ratio of heating and electric loads in connection with district heating and electric systems, the report concluding with a brief account of recent progress in station development.

A lively discussion followed the reading of this report, the point being emphasized strongly that a tremendous opportunity awaits the plant manager in bringing his employees together for discussions of their problems. A. C. Rogers told in detail of the steps in this direction taken by the Toledo Railways & Light Company and stated that previous reports of the association's station operating committees had been very useful in furnishing topics for discussion and in stimulating interest.

Secretary Gaskill told of similar work carried on by committees of the Ohio Electric Light Association, the practice being to gather the men together within a small compass geographically and have them addressed by a member of the association's committee, who was always reimbursed for his expenses in this connection.

ASSOCIATION PLEDGES SUPPORT TO GOVERNMENT

On motion made by George W. Martin the association adopted the following resolution:

"WHEREAS, The President of the United States has called attention to the depressing effects on the whole country of the discontinuance or lessening of the regular activities in various fields of business, and

"WHEREAS, Emphasis has been placed on the importance of stimulating food production for the needs of this country and our Allies; be it

"Resolved, That it is the belief of the members of the National District Heating Association, assembled in convention in Detroit, that it is also of paramount importance that conditions in the central station heating industry be preserved at or as near normal as may be consistent with the present state of labor and coal supply; and be it further

"Resolved, That the members of this Association pledge their aid to the Government in helping to solve any engineering problem in which their experience may be of value."

It was brought out in this connection that the recent appointment of the committee consisting of Davis S. Boyden, Charles R. Bishop and George W. Martin had been made at the express request of the Quartermaster-General's office in Washington to confer with the War Department regarding methods for heating the sixteen army cantonments, soon to be established at different points. While no decision was reached at the conference, held in Washington in May, it was learned that the heating requirements will involve the equivalent of 12,000,000 sq. ft. of direct radiation which would cost over $11,000,000.

This concluded the technical program for the day and the remainder of the afternoon was spent in the exhibition hall.

Morning Session, June 13

The first paper at the Wednesday morning session was contributed by Nelson S. Thompson, chief engineer for the office of the Supervising Architect, Treasury Department, Washington, D. C. Mr. Thompson had intended to describe the new government central heating plant in Washington to supply heat, power and electric light to twenty-one buildings in the capital.

Owing to war conditions the contemplated paper had to be laid over until after the war. Instead Mr. Thompson took up the operating costs in several government buildings in Washington, including the District Building, the new Washington Post Office and the National Museum group.

It was decided to publish this paper, which was read from manuscript, in the July issue of the association's Bulletin.

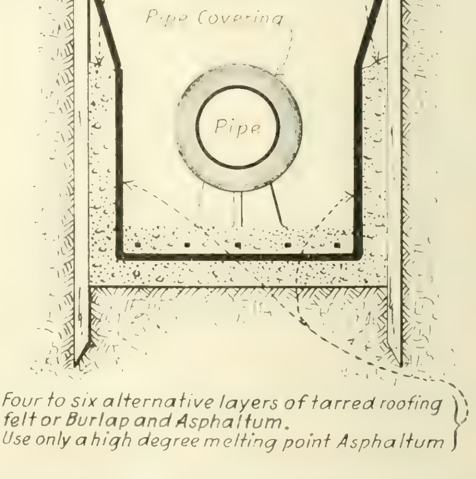
Professor J. D. Hoffman, of the University of Nebraska, then delivered an address on "A Study of District Heating in the Central West." Professor Hoffman devoted his address to conditions and the future outlook in Nebraska.

After referring to the prosperity that had come to the farmers of this section of the country, he described the evolution of farming methods which had brought in the use of machinery for all of the principal farm operations. With this development had come what Professor Hoffman termed the "misrepresentations" of machinery manufacturers which had led to many installations that were inadequate from an engineering standpoint. Nebraskans, he said, are slow to forget such things and the manufacturers do themselves a grave injury when they permit other than reliable apparatus to go in. Professor Hoffman spoke particularly of a case where the manufacturers' estimates of the capacity required in a boiler for a high school building varied from 75 per cent to 100 per cent. It was evident, he said, that if the lowest capacity boiler had been installed it would undoubtedly have been inadequate, with the possibility of a lawsuit. But the possible loss to the manufacturer, he said, in such an event, would have been small compared to the loss in prestige that would be experienced by that manufacturer. Professor Hoffman reported an analysis made of power plants in Nebraska which showed a total of thirty-eight power and lighting plants in the state. Of these twenty-two are steam plants, fourteen gas and oil, one steam and oil and one water power. Fourteen of these plants supplied heat. He said the tendency was toward the use of steam, rather than hot water, for heating.

Professor Hoffman made an important point when he stated that few cities and towns have community plans in view. As a rule there are no engineers on the town boards. Every town, he said, on reaching a certain size, should call in engineering advice with the express purpose of developing a community plan, so that there would be a comprehensive idea worked out for municipal improvements, including central heating service, as well as a co-ordination of such plans. He predicted that the community plan would be the next step in the government of towns and cities.

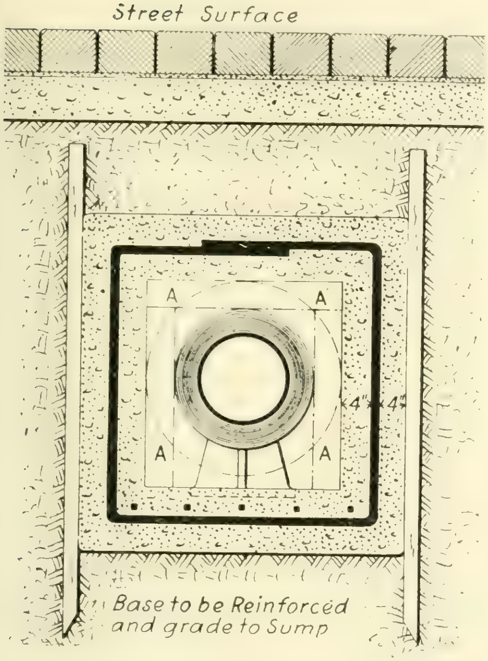
The report of the Underground Construction Committee was presented by H. A. Austin, chairman. This report dealt particularly with the waterproofing of underground steam and hot water mains. Illustrations were given of the methods used by the Interborough Rapid Transit Company in the subways in New York City, consisting of alternate lapped layers of tarred roofing felt, or burlap, and asphaltum as the waterproofing proper. Similar materials were used to form the waterproofing envelope surrounding the steam main installation proper of the New York Steam Company where the heating mains are located below mean high tide level.

A statement made in the report that leakage of water through the waterproofing brought out a rejoinder from E. B. Tyler that several of the railroads could show examples of waterproof construction. President Gifford stated that he had never seen a waterproof line. It


Street Surface
Temporary Position of water proofing during installation of Steam Main
Tongue and Groove Sheating
Preliminary Shell of Concrete
Concrete Mixture 1-2-4
Pipe Covering
Pipe

Four to six alternative layers of tarred roofing felt or Burlap and Asphaltum.
Use only a high degree melting point Asphaltum

WATERPROOF ENVELOPE PARTIALLY COMPLETED TO ALLOW FOR INSTALLATION OF STEAM MAIN.



A = Space to be used for any type of Steam Main Installation

– – –Wood Casing —·—Hollow Tile

COMPLETED WATERPROOF ENVELOPE FOR ANY TYPE OF STEAM MAIN INSTALLATION

should be remembered, he said, that the battery boxes in railroad work are carefully constructed in unit form while in laying underground pipe lines the work of waterproofing has to be done on the spot and usually in cramped quarters.

At the close of this session C. H. Spiehler, of Dayton, who is the engineer in charge of the construction of the army cantonment at the government aviation field in Dayton told some of the details of the heating equipment. Underground wood conduit is to be used for the pipe lines. There will be two units, each with its own water plant, involving a total of 10,000 to 12,000 lin. ft. of mains. The amount of radiation to be installed in this particular cantonment will be 92,000 sq. ft.

Afternoon Session, June 13.

George W. Martin, chairman of the Educational Committee, was the first speaker Wednesday afternoon. Reporting for his committee Mr. Martin presented several matters which had been taken up during the year, including tests with a new design for a stock kettle, to be used in connection with low pressure steam cooking, by J. W. Wattles, of the Boston Edison Illuminating Co.; test on the application of superheated steam to evaporating kettles superheated by electricity, by H. R. Wetherell; a discussion of steam consumption in a hotel kitchen, by J. H. Walker, of the Detroit Edison Co.; steam consumption of a department store restaurant, by E. F. Tweedy of the New York Edison Co.; test of a vegetable and soup cooker, by H. R. Wetherell; industrial heating by surface combustion, by E. F. Tweedy; and the adopting of sprinkler systems for heating buildings.

An interesting discussion arose over the possibility of using low pressure steam at about 2 lbs. pressure for cooking as against 30 lbs. pressure, as specified by the manufacturers. Mr. Walker said the manufacturers should be urged to change their requirements. Mr. Rogers said that frequently the piping as installed makes it impossible to use high pressure steam for cooking and the installation of new piping is out of the question.

At his suggestion Charles R. Bishop told of a series of experiments carried on at the plant of the American District Steam Company which had demonstrated conclusively that cooking could be successfully done in steam kettles with the steam at 2 lbs. pressure. In fact so successful were these experiments that the American District Steam Company is about to place on the market a full line of steam cooking kettles for operation at this pressure. This announcement brought forth enthusiastic comments. In the same connection it was brought out that in Seattle the central heating plant has 150 customers who use steam for cooking. For this service a special high pressure line had been installed when the system was first put in operation, but it was found that low pressure steam could be used successfully for this purpose, and as a result the high pressure line was discarded. All the cooking apparatus, however, was hand-made or altered to make it adaptable to the use of low pressure steam, which, in this case, was about 5 lbs.

Discussing the use of sprinkler systems for heating, one speaker brought up the point that the board of fire underwriters might object to this arrangement, due to the danger of scalding the occupants with hot water in case of fire. Ira N. Evans stated that as far as Massachusetts is concerned, where the system is in operation, the Board of Fire Underwriters had sanctioned its use.

The report of the Public Policy Committee S. M. Bushnell, chairman, was presented by Secretary D. L. Gaskill. This report took up economy among workmen, employers' liability and workmen's compensation laws, economy in the use of heating service, concluding with a discussion of rates for heating service. In the matter of rates the committee stated that "certainly in view of the advanced cost for supplies of every nature throughout the country, there should be no hesitation on the part of central heating companies in asserting their claim to at least a corresponding advance in the price of their commodity."

Before closing the session, the chairman introduced Colonel Dudley J. Hard of Troop A, Ohio National Guard, of Cleveland, who was one of the six men who founded the National District Heating Association. Col. Hard expressed his pleasure at being present and stated that he was glad the association had voted to hold its convention this year because now if ever was a time when such a business as district heating should be carried on with the highest degree of efficiency.

Morning Session, June 14.

Most of the Thursday morning session was taken up with the presentation and discussion of the report of the Heating Research Committee. This report was prepared by a joint committee, of which D. S. Boyden was chairman, representing the New England Section of the N. E. L. A. and the National District Heating Association. The report was the result of certain isolated plant discussions in which it was charged by a representative of a large manufacturer operating an isolated plant that central station companies were long on information as to electric costs and operation, and, by clever salesmanship and otherwise, solicited the electric light and power business, but, after getting the electric business, left the customer, in many cases, without any advice or assistance as to the operation of his steam heating requirements.

The information brought out in the report included detailed records of actual steam operating costs in thirty-three different buildings of various types, compiled with a view of enabling the companies intelligently to solicit the large customer and then to educate him in the economical use of his steam service. An outline was also given of the policies to be followed by the central station companies in advising, supervising or operating the customer's steam plant in the event of his adoption of central station service. The detailed information as to costs was supplemented by two condensed tables, one giving the figures for the annual unit consumption in these thirty-three buildings per square foot of floor area and the other giving the annual unit consumption per 1,000 cu. ft. of volume. The consumption figures per square foot of floor area averaged about 16 lbs. of coal and 117 lbs. of steam. The unit consumption per 1,000 cu. ft. of volume averaged about 830 lbs. of coal and 8,657 lbs. of steam. Included in the list of buildings were department stores, a municipal office building, general office buildings, hotels, hospitals, shoe factories, machine shops, a church and residence, a candy factory, an automobile and carriage factory, tenant manufacturers, and camera, optical instrument, jewelry and carpet factories, together with a combination apartment, store and machine shop.

The remainder of the session was given up to a discussion of accounting methods for district heating companies, President Gifford and others taking part in the discussion.

Afternoon Session, June 14.

All of the Thursday afternoon session was devoted to a discussion of rates and this session was easily the most vital of the entire convention.

The discussion was opened by Secretary D. L. Gaskill who said that every member company represented had been brought face to face with the rate situation during the past six months and that the trend of affairs was decidedly in the wrong direction.

The rates of both heating and electric companies, he said, have been based too much on what someone else has done. The first step in establishing rates should be the determination of costs based on a valuation of the property, physical and intangible.

He predicted that within ten years rates would become so standardized that the matter would no longer be open for discussion, but in the meantime, with so many companies operating, under present conditions, on losing contracts, it was essential that a revision be made without delay.

It had been thought that the cost of fuel was fairly fixed, but with the unheard of advances, in recent months, in the price of coal, an entirely new situation confronted the companies.

Mr. Gaskill declared that the commissions are advancing faster than the companies in the matter of rates and he cited the recent ruling of the Ohio Public Service Commission which provides, among other things, that all contracts must conform to the existing rates, and there was no reason why the heating companies should not file supplementary schedules, which, if allowed by the commission, would become effective on all contracts for heating service.

Mr. Gaskill then spoke at length on the coal situation and expressed the opinion that rather than enter into coal supply contracts at the present prices, he would urge a waiting policy as he anticipated there would be effective relief as regards the coal situation before the heating season opened again.

Much of the ensuing discussion was of a confidential nature, but among the many points brought out was the upward jockeying of coal prices by the operators, being, it was declared, out of all proportion to the increase in the cost of mining and transporting the coal.

All of the speakers came out unreservedly in favor of an immediate raise in rates. In this connection it was stated that the same rates were not necessarily applicable in two cities of the same size, and evidence was given to show that the cost of steam production and distribution sometimes varies, in such cases, as much as 17 per cent. "You must not figure against gross dollars," declared the speaker, "but against the thermal efficiency of the plant."

Detailed evidence was presented by another speaker showing how the coal company's prices were arbitrarily raised and then lowered when it became evident the sale could not be effected at the higher figures.

As showing the possibilities in the reasonable raising of rates, President Gifford quoted from the recent decision of the Indiana Public Service Commission *re* the Frankfort Heating Company. The commission, in this case, authorized a raise in rates from 17 cents to 20½ cents, which it was estimated would give a net profit of 7 per cent on the valuation and an additional 2 per cent for a depreciation reserve fund.

It was then suggested that any proposed rate increase should not be based on the higher cost of coal alone, but also on increased labor and other costs as well.

Contracts, with coal riders, were not

generally approved of by utility commissions, and in one case it is proposed to ask for a straight percentage increase, covering the cost of coal and labor.

One speaker brought the convention almost to its feet by declaring that the present situation may mean life or death to the heating companies, that it was impossible for them to make money under the present conditions and that there was no need for further discussion—"the rates must be raised."

It was suggested that it might be possible to co-operate as an organization with other associations which are large users of fuel to effect a lowering of coal prices and details were given of steps that could properly be taken in this connection.

It was brought out that John W. Lieb, vice-president of the New York Edison Company has been appointed to a place on one of the government boards that has to do with the coal supply and that members might receive substantial aid by letting him know of their coal troubles. His headquarters in Washington are at 1111 Munsey Building. Steps have already been taken in New York to conserve the fuel supply next winter and its distribution through daily co-operation between the various interests.

The discussion closed with a stirring admonition to "Go home and raise your rates."

NEW OFFICERS.

The report of the nominating committee was presented by H. A. Austin, chairman, as follows:

President, George W. Martin, of New York.

First vice-president, J. C. Hobbs, Pittsburgh.

Second vice-president, J. L. Hecht, Chicago.

Third vice-president, O. M. Rau, Milwaukee.

Secretary-treasurer, D. L. Gaskill, Greenville, O.

Executive committee: above-named officers and W. A. Wolls, Indianapolis; J. H. Walker, Detroit; and C. A. Gillham, New York. An independent nomination was made of A. C. Rogers, Toledo, for member of the executive committee. The election, the next day, confirmed the nominations of the officers. For members of the executive committee (two to be elected) the candidates chosen were A. C. Rogers, of Toledo, and J. H. Walker, of Detroit.

Morning Session, June 15.

The report of the Meter Committee, J. H. Walker, chairman, was divided into four sections, dealing respectively, with recent improvements in steam flow meters, with special reference to the Republic flow meter; with new condensation meters, including the Mason meter and the Tyler meter; with standard tests for condensation meters; and with comparative operating data.

Three standard methods of testing condensation meters were suggested by the committee which were described as temperature accuracy tests, load accuracy tests and steam pressure accuracy tests.

George W. Martin presented the report of the committee on Valuation Terminology. He said that at a joint meeting with representatives of other associations it was decided that each organization should develop its own definitions of terms used in appraisals of public utility properties, and turn them over to a committee of the N. E. L. A. which will act as a clearing house in the work.

H. C. Kimbrough presented a map of the United States showing all of the existing steam and hot water central heating in the country brought up-to-date.

The new president, Mr. Martin, was then installed and made an address, expressing his appreciation of the honor conferred and pledging his efforts toward the furtherance of the association's interests. He declared that service was the keynote that should dominate the members.

Vice-President J. C. Hobbs was also introduced and made a suitable response.

Under topical discussions a paper by R. C. Marsh was presented on "Loss of

Heat Through Insulation," describing results obtained on a single-pipe, forced hot-water system. The test showed the temperature of the water at successive points on the system under varying conditions of outside temperature. The temperatures were obtained by mercury thermometers of the maximum type in thermometer wells filled with heavy oil.

C. B. McMillan stated that such tests were not very conclusive owing to the variation of the soil temperatures. Another determining factor is the depth of the pipes in the ground.

President George W. Martin discussed the subject of "Ash and Coal Handling Problems." Mr. Martin said that during the past winter many plants in New York were forced to burn crushed coke, owing to the scarcity of coal. Culm, or anthracite dust, was also tried, but without success. Mr. Soucy told of better success he had obtained in burning culm and it was brought out that the weathering of the culm was an important factor in this connection. No. 3 buckwheat is now being successfully burned on the new types of Cox stokers. Ejection of ashes by steam and water was also discussed and the new developments described.

George L. Flechsenhaar presented a topic on "Efficiency of Consumers' Installations in Relation to Central Station Supply." This paper was a general discussion of the subject supplemented by a typical case showing the savings effected through co-operation with the consumer who had complained of what he called exorbitant charges. During the succeeding month the system was operated by the company, showing a total of 441,000 lbs. of condensation with an outside temperature of 21.6° F., as compared with a total of 579,000 lbs. the previous month with an average outside temperature of 27.9° F. This, he stated, was an instance showing the value of teaching the consumer how to operate his system for economy.

The discussion brought out the fact that the average installations in residences and similar buildings were usually skimped and inadequate so that it was important to see that better installations were made. Every poor building installation not only makes good service difficult but is a handicap on the entire central heating industry.

The convention concluded with the passage of the important resolutions already referred to, regarding the rate question and fuel supply, and also resolutions of thanks to the officers and committees and a special resolution regarding the hold-over of the associations' officers in case war conditions should prevent the calling of next year's convention.

The Entertainment.

Although the fickle weather god, who has been disturbing the elements all Spring, was still in a frowning mood, he had the grace to interfere as little as possible with the entertainment of the delegates and guests. For the first two days the weather was all that could be desired, but after that it grew colder and cloudy.

On the opening day of the convention there were card parties for the ladies and these were followed, the next day, by theatre parties.

On Wednesday evening a dinner, with cabaret and dancing, was held in the Grill Room of the Pontchartrain and proved a merry affair. Between showers of confetti and streamers of paper, all formality was soon thrown to the winds, while the scene itself, with the diners in paper caps of variegated hues and shapes, was as bizarre as one could wish. The speechmaking was necessarily short and to the point, the principal item after a toast to the President and our allies being the presentation by Secretary D. L. Gaskill of a gold medal to the retiring president, Byron T. Gifford. Colonel Hard, of Troop A, O. N. G., who was one of the organizers of the association, also spoke, being followed by George W. Martin, who was later elected president.

Thursday afternoon the ladies toured the city in automobiles and in the evening there was a theatre party for all at the Temple Theatre.

The concluding feature was a boat ride for all to St. Clair Flats on Friday afternoon, immediately following adjournment of the convention.

L. S. Shaw, as chairman of the entertainment committee, was warmly congratulated for his successful efforts in connection with the general arrangements, especially the dinner. The sub-committee chairmen who saw that their parts of the entertainment were carried out without hitch were: Card party, A. D. Spencer; moving picture show, A. G. Crocker; automobile ride, J. V. Redfield; banquet, L. S. Shaw; theatre party, William Owen; boat ride, A. G. Crocker; reception, A. D. Spencer.

The contributors to the entertainment fund included the Allis-Chalmers Mfg. Co., American District Steam Co., Armstrong Cork & Insulation Co., Central Station Steam Co., Detroit Stoker Co., General Electric Co., H. W. Johns-Manville Co., Michigan Power Co., Murphy Iron Works, Detroit Edison Co., Westinghouse Electric & Mfg. Co. and Wright Mfg. Co.

Convention Notes.

The success of the company section idea was attested by the reports from the Toledo section, which is the first city to have such a section in the N. D. H. A. A similar section has been formed in New York of employees of the New York Steam Company.

Professor John R. Allen, who was the principal speaker at the Tuesday afternoon session, came in for many congratulations on his election as dean of the College of Engineering and Architecture of the University of Minnesota, in Minneapolis. Professor Allen has been professor of mechanical engineering at the University of Michigan for 21 years. He stated that his researches and tests in connection with heating and ventilation will be continued at the University of Minnesota, a special appropriation having been made by the university at his instance for carrying on this work.

The election to membership of Nicholas P. Melnikoff, of Petrograd, Russia, was commented upon as a reminder of the possibilities in Russia that will be presented after the war.

One of the interesting movements started by the association is a roll of honor of those members who have gone to the front, as well as those who are in the service of the government in other ways. This roll will be kept on file at the secretary's office and members and others are asked to send in the name of any members they know of who are in government service.

A substantial evidence of the war business that is to come to manufacturers of central heating apparatus was the contract received by the American District Steam Company for all of the underground wood pipe casing to be installed at the army aviation camp at Dayton. This order alone amounted to $48,000.

One of the first companies to raise its rates as a result of the prevailing prices of fuel and other materials, it was brought out, is the New York Steam Company, which filed its supplementary schedule June 1, with the New York Public Service Commission. In this connection attention was called to a ruling of the commission to the effect that the approval by the commission of the new rates makes them apply automatically to existing contracts, whether or not lower rates are specified in such contracts.

Considering war conditions and the fears expressed by many of the members that the convention might better have been given up this year, the attendance of 128 active and associate members was considered remarkably good. The absence of some members was due to the loss of men in the plants, who have enlisted for active service.

Among the Exhibitors.

A total of 25 exhibits on display in the room adjoining the convention hall proved one of the most attractive features of the convention. Many new devices, as well as the latest developments in standard apparatus were shown, in some cases in operation.

Precision Instrument Co., Brooklyn, N. Y., showed types of its CO_2 recorders, Orsats, micrometer gauges, indicating and recording portable gauges for vacuum and pressure, steam, water and gas. Paul Jones, sales manager of the company, was in charge.

Minneapolis Heat Regulator Co., Minneapolis, Minn., had on exhibition different models of its heat regulators, including Model No. 55, with A. C. motor, operating on 110 volts, which has a duplex clock attachment by which it will operate at different temperatures day and night. Harold W. Sweatt, vice-president, and C. A. Scholle, Ohio representative, had charge of the company's interests.

Chapman Valve Mfg. Co., Indian Orchard, Mass., displayed one of its large self-packing valves and one with a wheel top. F. W. Sleep, New York manager, and Thomas Maher, were on hand for the company.

Detroit Lubricator Co., Detroit, Mich., showed its line of packless radiator valves, house-heating boiler safety top valves and fusible plugs and water gauges. J. S. Crane, advertising manager, had charge of the exhibit, and others present included H. I. Lord, vice-president and sales manager, and George Cage, assistant sales manager.

Chamberlin Metal Weather Strip Co., Detroit, Mich., had models of its double-hung window equipment, door equipment and casement window equipment. Those on hand for the company were J. P. Glaser, general sales manager and W. H. Stevens.

Wright Mfg. Co., Detroit, Mich., showed the Wright improved safety alarm water column, Murray feed water regulators, Austin steam and oil separators and other specialties. H. C. Van Sickle, of the Detroit office, was in charge.

Jenkins Bros., New York, had on exhibition various types of fractional valves, also Babbitt adjustable sprocket rim for valve handles, Kantsplit valve wheels, Jenkins '96 packing and Manhattan self-lubricating packing. R. B. Osgood, of the company's Chicago office, had charge of the exhibit.

Central Station Steam Co., Detroit, Mich., showed a full-size model, in operation, of the Detroit continuous-flow condensation meter, together with one of its double style A diaphragm-type expansion joints. Those present for the company included J. V. Redfield, president; W. R. Owen and W. G. Bryant.

American District Steam Co., North Tonawanda, N. Y., had an exhibit which included the Simplex condensation meter and the St. John flow meter, both in operation; also models of its underground construction for pipe lines, and the Adsco specialties for use with the Adsco system of Atmospheric heating. The company's representatives were William H. Wells, president; Charles R. Bishop, secretary; H. C. Kimbrough, Western manager; W. J. Kline, sales engineer; R. C. Holly, manager of the Atmospheric department; Lloyd Howell, of the Chicago office and C. S. Williams, of the home office.

A. M. Byers Co., Pittsburgh, Pa., had an interesting exhibit consisting of samples of Byers genuine wrought-iron pipe, taken from the heating system in the Eden Musée, New York, after 33 years' service; also a piece of 6-in. pipe taken from Wood Street, Pittsburgh, after 28 years' service, and many other samples, including various sizes of pipe manufactured by the company, both black and galvanized. E. B. Pierce and Fletcher Collins, took care of the company's interests.

Illinois Engineering Co., Chicago, Ill., showed a radiator equipped with an Illinois modulating supply valve and radiator thermostatic trap. There were also on display an Eclipse pressure-reducing valve especially designed for vacuum heating work, and an Eclipse combination back pressure and relief valve; also an Eclipse low pressure dash-pot reducing valve. J. C. Matchett, secretary, and H. H. Hughson, Michigan representative, were in charge.

National Air Cell Covering Co., Jersey City, N. J., also had a durability exhibit. At one end of the table was a section of double standard-thickness Pyrobestos insulation that had been in the ground 8 years. To all appearances it was similar in appearance to an adjoining length of new Pyrobestos insulation, having in no way deteriorated. The company also showed a section of Pyrobestos that had been in water for four years without showing any ill effects. C. C. Hall, of the home office, was on hand for the company.

Tyler Underground Heating Systems, Pittsburgh, Pa., had a booth but no display. E. B. Tyler, president of the company, and Fred G. Otto, engineer and salesman, were present.

National Tube Co., Pittsburgh, Pa., had on exhibition samples of tests made on National boiler tubes. The exhibit also included a unique pyramid of National pipe, including sizes from ¼-in. to 30 in. in diameter. Samples of Kewanee specialties were shown, including Kewanee unions and Kewanee regrinding valves. The company's representatives in attendance were H. R. Redington, H. W. Collins, L. F. Hamilton, A. M. Lally, A. F. Taylor and C. E. Kennish.

J. C. Hornung, Chicago, Ill., showed types of his steam or water pressure control valves, temperature control for either steam or hot water, combined pressure and temperature control valve; also four types of thermostats, air, water and electric, and electric with clock for automatically turning the temperature back during the night hours; tank regulators for controlling domestic hot water tanks, the Hornung magnetic pilot valve for re-establishing temperature control when air lines have failed, and Debonite central station pipe covering for underground mains. J. C. Hornung had charge of the exhibit.

Armstrong Cork & Insulation Co., Pittsburgh, Pa., displayed models showing the setting and drums of a water-tube boiler insulated with Nonpareil insulating brick, and an underground line covered with Nonpareil high-pressure covering. There were also shown Nonpareil high-pressure block and cements, Nonpareil corkboard for cold storage insulation and Nonpareil cork covering for brine and ice water lines. A. B. Alexander and C. E. Schoeneman represented the company.

General Electric Co., Schenectady, N. Y., had an exhibit containing full size models of its flow meter in three types, with the accessories. There was also a stereomotorgraph in the company's booth, showing typical flow-meter installations. The company's factory representative was R. E. Woolley and its Detroit representative, A. E. Ingersoll.

V. D. Anderson Co., Cleveland, O., showed samples of its Model D steam trap, Junior steam trap and air trap; also the Anderson line of steam and oil separators. Joseph H. Meyer, the company's Detroit representative, was in charge.

W. H. Pearce & Co., Chicago, Ill., exhibited a new device, consisting of a Crescent heat controller, for controlling the heat in a number of buildings from the power house. The company also had types of the Crescent steam meters and the Crescent conduit construction. The company was represented by W. H. Pearce, W. H. Pearce, Jr., of Chicago, and H. J. Clemons, of the Detroit office.

Bailey Meter Co., Boston, Mass., showed one of the Bailey fluid meters, Type C2 and Ervin G. Bailey, president of the company, was on hand to explain its construction and operation.

Ric-Wil Co., Cleveland, O., exhibited a model of its underground insulated conduit for heating mains, showing the construction used for both single and multiple pipe lines. This model was uniquely arranged before a large mirror so that both sides of the conduit could be seen from the front. The company was represented by F. H. Stevens, Chicago manager.

Fremont Mfg. Co., Fremont, Mich., had a popular exhibit showing the operation of a Bacon portable pipe-cutting and pipe-threading machine. This machine is a self-contained unit and was operated by a small gasoline motor. It cut and threaded various sizes of pipe up to 6-in. Louis Webber, general manager of the company, and A. F. Bacon, the inventor of the apparatus, were present, Mr. Bacon personally operating the machine.

L. S. Shaw & Co., Detroit, Mich., exhibited the Detrick flat suspended arch for steam boilers and furnaces, also a working model of the Connelly boiler, made by D. Connelly Boiler Co., Cleveland, O. L. S. Shaw, president, and F. A. Green, had charge of the exhibit and distributed matter on Terry turbines, Vater water softeners and the General Concrete Construction Company's chimneys.

Republic Flow Meter Co., Chicago, Ill., had its Type F and Type C steam flow meters in operation. There was also a section of a meter showing its construction. The company exhibited a new Pitot tube which was featured as being non-plugging; and a new resistance element, the contact rods of which are graduated to the square root function. There was also a Republic recording hydrometer on exhibition. J. D. Cunningham, president, and C. E. McGregor, were in charge.

H. W. Johns-Manville Co., New York, showed different sizes of the J-M steam trap, J-M underground conduit installation (full-size model) indicating the method of supporting pipe and providing for underdrainage. The company's representatives were H. McKinley, manager of the power specialty department for Michigan and Ohio; J. B. Webb, Detroit representative, and L. B. McMillan, engineer for the general power specialties department.

Those Present:

Active Members.

Byron T. Gifford, Grand Rapids, Mich.
D. L. Gaskill, Greenville, Ohio.
Geo. W. Martin, New York Service Co., New York.
A. E. Blosser, Lockport Lt. Ht. & Pr. Co., Lockport, N. Y.
E. R. Little, Little & Shepard, Detroit, Mich.
W. H. Ballard, W. H. Ballard & Co., Boston, Mass.
O. F. Rabbe, Toledo Railways & Light Co., Toledo, O.
A. C. Rogers, Toledo Railways & Light Co., Toledo, O.
Geo. J. Kerth, Overbrook Steam Heating Co., Philadelphia, Pa.
Elmer B. Plapp, Allegheny Co. Steam Heating Co., Pittsburgh, Pa.
James Lynch, Home Heating Co., Erie, Pa.
W. G. Carlton, Grand Central Terminal, New York.
H. A. Austin, New York Steam Co., New York.
H. J. Klotz, Decatur Railway & Light Co., Decatur, Ill.
L. R. Crawford, Sioux City Service Co., Sioux City, Ia.
E. L. Kirk, Sioux City Service Co., Sioux City, Ia.
Robt. Ilett, Valentine Heating Co., Toledo, O.
O. M. Rau, Commonwealth Power Co., Milwaukee, Wis.
Vernon M. F. Tallman, Worcester Elec. Light Co., Worcester, Mass.
C. J. Cooper, Jr., Merchants Heating and Lighting Co., Indianapolis, Ind.

C. H. Spiehler, Dayton Power & Light Co., Dayton, O.
Thos. F. Kelly, Dayton Power & Light Co., Dayton, O.
F. R. Brosius, Union Gas & Elec. Co., Cincinnati, O.
A. B. Grubmeyer, Cons. Gas Elec. Light & Power Co., Baltimore, Md.
John R. Allen, University of Michigan, Ann Arbor, Mich.
J. D. Hoffman, University of Nebraska, Lincoln, Nebr.
Geo. H. Alexander, Frankfort Heating Co., Frankfort, Ind.
Jno. Devine, Miami University, Oxford, O.
Dudley J. Hard, Cleveland Light & Power Co., Cleveland, O.
J. W. Pyle, Peru Heating Co., Peru, Ind.
C. H. Henze, Hiram Walker & Sons, Walkerville, Ont.
A. H. Lamond, Michigan Power Co., Lansing, Mich.
A. W. Higgins, Mineral Point Public Service Co., Mineral Point, Wis.
D. A. Brown, Shorthand Reporter, Cincinnati, O.
J. C. Hobbs, Duquesne Light Co., Pittsburgh, Pa.
F. S. Karn, Duquesne Light Co., Pittsburgh, Pa.
J. G. Hauser, U. & C. Railway Gas & Electric Co., Champaign, Ill.
C. F. Snyder, B. N. Railway & Light Co., Bloomington, Ill.
Geo. L. Flechsenhaar, Illinois Traction System, Champaign, Ill.
W. J. Fitzgerald, Detroit-Edison Co., Detroit, Mich.
H. F. Winte, Detroit-Edison Co., Detroit, Mich.
Arthur S. Allbright, Detroit-Edison Co., Detroit, Mich.
Chas. C. Munroe, Detroit-Edison Co., Detroit, Mich.
Russell W. Symes, Detroit-Edison Co., Detroit, Mich.
A. D. Spencer, Detroit-Edison Co., Detroit, Mich.
J. B. Kellogg, Detroit-Edison Co., Detroit, Mich.
James Trombley, Detroit-Edison Co., Detroit, Mich.
J. H. Walker, Detroit-Edison Co., Detroit, Mich.
A. VanVlict, Detroit-Edison Co., Detroit, Mich.
Norman W. Calvert, Detroit-Edison Co., Detroit, Mich.
Arthur J. Duke, Detroit-Edison Co., Detroit, Mich.
Chas. C. McAllister, Vandergrift Steam Heating Co., Vandergrift, Pa.
J. F. Horn, Vandergrift Steam Heating Co., Vandergrift, Pa.
Andrew Pinkerton, Vandergrift Steam Heating Co., Vandergrift, Pa.
Sam B. Mott, Noblesville Heat, Light & Power Co., Noblesville, Ind.
D. D. McEachin, City Municipal Plant, Hibbing, Minn.
Master D. D. McEachin, Hibbing, Minn.
D. D. Haley, City Municipal Plant, Hibbing, Minn.
J. D. Rooney, Hibbing, Minn.
Ira N. Evans, Johnson, Larsen & Co., Detroit.
J. F. Lewis, U. S. N.
C. A. Hamilton, Consumers Power Co., Saginaw, Mich.
Henry Meyer, Citizens Mutual Htg. Co., Terre Haute, Ind.
Geo. D. Higgins, 60 Penobscot Bldg., Detroit, Mich.
Geo. J. Soucy, Consumers Heating Co., Kitchener, Ont.
J. N. Moncrieff, Wis-Minn Light & Power Co., LaCrosse, Wis.

Associate Members.

C. Seymour Williams, American District Steam Co., N. Tonawanda, N. Y.
Lloyd Howell, American District Steam Co., Chicago.
R. C. Holley, American District Steam Co., N. Tonawanda, N. Y.
Walter J. Kline, American District Steam Co., N. Tonawanda, N. Y.
Charles R. Bishop, American District Steam Co.
William H. Wells, American District Steam Co., N. Tonawanda, N. Y.
A. G. Crocker, Westinghouse Electric & Mfg. Co., Detroit, Mich.
Jas. C. Matchett, Illinois Engineering Co., Chicago.
R. B. Osgood, Jenkins Bros., Chicago.
E. G. Bailey, Bailey Meter Co., Boston.
R. E. Woolley, Gen. Elec. Co., Schenectady.
F. H. Stevens, The Ric Wil Co., Chicago.
Frank A. Green, L. S. Shaw Co., Detroit.
L. S. Shaw, L. S. Shaw Co., Detroit.
Martin A. Rooney, American Radiator Co., Detroit.
Thomas Wilson, *Power*, Chicago.
E. L. Downs, U. S. Radiator Corporation, Detroit.
J. S. Crane, Detroit Lubricator Co., Detroit.
Fletcher Collins, A. M. Byers Co., Pittsburgh.
E. B. Bierce, A. M. Byers Co., Pittsburgh.
F. F. Vater, Power Plant Specialty Co., Chicago.
Charles H. Bishop, *Metal Worker*, Chicago.
Jas. D. Cunningham, Republic Flow Meters Co., Chicago.
A. Cameron, General Electric Co., Detroit.
A. E. Ingersoll, General Electric Co., Detroit.
Jos. H. Meyer, V. B. Anderson Co., Cleveland.
H. W. Collins, National Tube Co., Pittsburgh.
H. R. Redington, National Tube Co., Pittsburgh.
L. F. Hamilton, National Tube Co., Pittsburgh.
G. C. Hall, National Air Cell Covering Co., Jersey City, N. J.
W. H. Pearce, W. H. Pearce Co., Chicago.
W. H. Pearce, Jr., W. H. Pearce Co., Chicago.
A. S. Armagnac, The Heating and Ventilating Magazine, New York.
H. C. VanSickle, Wright Mfg. Co., Detroit, Mich.
R. A. Foreman, Westinghouse Electric & Mfg. Co., Chicago.
A. F. Bacon, Fremont Mfg. Co., Fremont, Mich.
Louis Webber, Fremont Mfg. Co., Fremont, Mich.
Arthur Metzger, Alberger Pump & Condenser Co., Chicago.
H. McKinley, H. W. Johns-Manville Co., New York.
L. B. McMillan, H. W. Johns-Manville Co., New York.
J. B. Webb, H. W. Johns-Manville Co.
Gordon D. Cooke, McGraw-Hill Publishing Co.
E. B. Tyler, Tyler Underground Heating Systems, Pittsburgh.
Ford G. Otte, Tyler Underground Heating Systems, Pittsburgh.
Claude Bowlus, American School of Correspondence, Scranton, Pa.
J. C. Hornung, 343 No. Dearborn St., Chicago.
Geo. D. B. VanTassel, Power Specialty Co., Chicago.
F. W. Sleep, Chapman Valve Mfg. Co., New York.
Thos. T. Maher, Chapman Valve Mfg. Co., New York.
C. B. Veal, Central Station Steam Co., LaFayette, Ind.
Geo. C. King, Central Station Steam Co., LaFayette, Ind.
W. R. Owen, Central Station Steam Co., Detroit.
W. G. Bryant, Central Station Steam Co., Detroit.
J. V. Redfield, Central Station Steam Co., Detroit.
H. H. Hughson, 160 Tuxedo Ave., Detroit.
H. C. Kimbrough, American District Steam Co., Chicago.
F. T. Schieiner, Jr., McAlear Mfg. Co., Detroit.
Paul Jones, Precision Instrument Co., Detroit.
E. P. Fitzgerald, Roe Stephens Mfg. Co., Detroit.
C. E. McGregor, Republic Flow Meters Co., Chicago.

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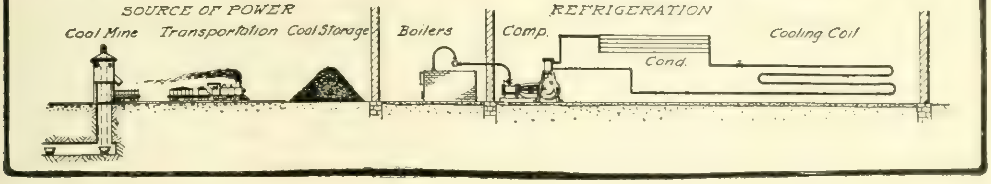
Health Perils of Munition Workers.

Some of the dangers that munition workers are exposed to and how they can be avoided is told by Dr. W. A. Evans in the *Chicago Tribune.* From all parts of the world, he states, where high explosives are manufactured, there come reports of serious and sometimes fatal poisonings due to the fumes and dust. The workers in the Dupont factories, however have largely escaped such injuries and among the precautions taken by this company are the following:

In the acid rooms the men suffer from acids splashing and acid fumes. All munition factory rooms are thoroughly ventilated. The air is removed by exhaust fans through multiple outlets in the floors, and fresh air enters through multiple inlets located in the ceiling. Near every acid vat there are water nozzles, tubs or showers. When a man gets a splash he turns on the water or jumps into a tub at once. Next he applies saturated solution of bicarbonate of soda until the foaming stops. Next he applies a burn ointment.

AIR COOLING AND REFRIGERATION



Refrigeration by the Absorption System

Refrigeration by means of the compression system having been previously discussed in these columns it is assumed that the reader is thoroughly familiar with the theory and principles involved in this method of cooling, and it is now desired to take up refrigeration as carried on in what is commonly termed the "absorption" system. In this system no compressor is necessary, its place being taken by the generation of pressure produced in evaporating ammonia by means of heat largely in the manner employed in the common steam boiler, excepting that the temperature is not quite as high.

THEORY OF ABSORPTION SYSTEM.

The theory is more easily grasped by reference to Fig. 1 which shows diagrammatically the primary process of refrigeration by absorption. In this figure A represents a closed cylinder connected by a pipe P to another closed cylinder B. The second cylinder sets in a tank T-2 which is filled with water W from the water pipe WP, while the first cylinder sets in a tank T-1 and can be sprayed from time to time by the sprays S from the cold water line CW. The water from the sprays flows off through the drain D and heat can be applied to the cylinder when desired by means of the flame F. The tank T-2 may be emptied by opening the drain valve DV.

OPERATION OF APPARATUS.

To operate the apparatus, A is filled with a quantity of highly charged aqua ammonia, which is water containing ammonia and must be clearly distinguished from anhydrous ammonia which is commercially pure ammonia without water. Heat is then applied to A, (the sprays not being in operation) and as A becomes heated the ammonia begins to vaporize, the air above the ammonia being allowed to pass out through the relief cock R. As soon as the air is expelled the cock is shut and the evaporating ammonia then builds up the pressure in A, P and B until the low temperature produced in B by the cooling water W combined with the excessive pressure generated by A owing to the flame F results in liquefying the gas in cylinder B; this corresponding exactly to the high pressure produced by the compressor in the compression system and the cooling and condensing of the gas in the condenser. The pressure produced in this apparatus is about 120 lbs. per square inch which raises the boiling point of the water retained in A to about 230° F., thus preventing the vaporization of the water at the time the ammonia is liberated at the increased temperature.

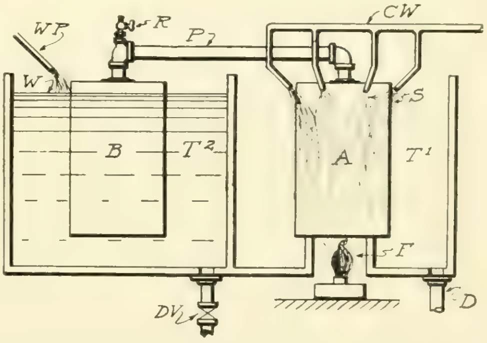


FIG 1.—DIAGRAM ILLUSTRATING THEORY OF ABSORPTION SYSTEM OF REFRIGERATION.

After an interval of time the water in tank T-2 is drawn off and replaced with whatever substance it is desired to refrigerate. The water spray S is then turned on tank A and the flame F removed. The cooling of A by water spray cools and condenses the gases contained therein and relieves the pressure on the whole system at which time the liquid anhydrous ammonia which has collected in tank B begins to vaporize owing to removal of the pressure and in so doing takes up the heat from the surrounding liquid or substance to be cooled, thus producing the refrigerating effect. This, in brief, is the principle of the absorption system, as the gas after evaporization passes back into tank A and is absorbed by the water therein.

PRACTICAL APPLICATION OF ABSORPTION SYSTEM.

In the practical operating plant conditions are more involved and the careful study of its parts must be made. Fig. 2 shows a diagrammatical elevation of a practical plant the cycle of the process being as follows: The aqua ammonia is placed in still S which corresponds to the original chamber A in Fig. 1, while to produce heat in the still a spiral steam coil is installed. The ammonia gas is driven from the still (by the heat of the steam coil) and passes up the vapor pipe V to the dehydrating coil DH which is enclosed in a tank filled with water at about 150° F. At this temperature whatever water may be contained in the vapor condenses but the ammonia still remains a gas. After passing through the dehydrating coil the condensed water and ammonia gas pass down into a separating tank ST. From the bottom of the separating tank the raw water or condensation returns to the still through the pipe RW while the pure ammonia gas passes through the ammonia gas pipe AG to the condenser D which consists of a group of coils, either water or air cooled. In this part of the system the ammonia is cooled and under its pressure condenses in a manner similar to the action in a compression system.

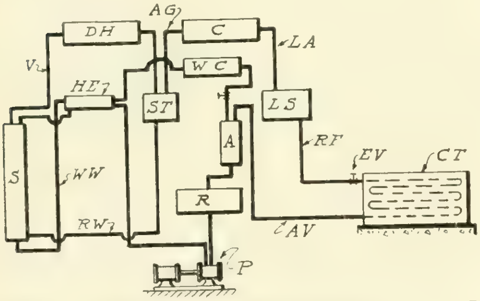


FIG. 2.—TYPICAL ARRANGEMENT OF ABSORPTION SYSTEM.

It must be remembered that the vaporizing of the ammonia in the still S produces a pressure of about 150 lbs. which is maintained all through the system up to the condenser.

REFRIGERATING PROCESS.

The ammonia is now ready for use having been liquefied, cooled and compressed to a pressure of 150 lbs. per square inch. From the condenser C it flows through the liquid ammonia pipe LA to the liquid storage tank LS and then through the refrigeration pipe RF to the expansion valve EV which allows the ammonia to expand and refrigerate in the coil contained in the cooling tank CT, in which coil a pressure of about 15 lbs. is maintained. From the cooling tank the expanded ammonia gas goes through the ammonia vapor pipe AV to the absorber A in which it enters at the top and meets a flow of water so as to thoroughly intermingle and be absorbed by the water.

To understand where this water comes from it is necessary to go back to the ammonia still S and remember that the water which has been freed from the gas is retained in this still. This is termed "weak water" and after expelling the gas it is allowed to flow from the still through the weak water connections WW to the heat exchanger HE. Here it is cooled and then passes on to the weak water cooler WC, where it is further cooled by cold water, and from this point it is allowed to flow into an absorber A and furnishes the water supply to absorb the returning gas from the cooling tank. After this absorption has taken place aqua ammonia results which flows into the reservoir R. The pump P then draws the cool aqua ammonia from the reservoir and discharges it through the heat exchange tank HE back into the still S. Thus the heat of the weak water flowing to the absorber is transferred to the aqua ammonia coming back from the absorber to the still and it therefore requires less heat in the still S to re-vaporize the ammonia so as to repeat the cycle.

NOTES

The United Cork Companies, Lyndhurst, N. J., have issued an interesting new catalogue of 152 pages and 97 illustrations for the use of those interested in insulation work. This catalogue gives much information regarding the advantages of cork for refrigeration work.

The De La Vergne Machine Co., New York, has issued two new bulletins, No. 61 which compares the horizontal and vertical types of ammonia compressors, and No. 60 on ammonia purifiers.

Heating Standards Adopted by the Chicago Master Steam Fitters' Association

The need of standard practice for heating installations in such buildings as apartments and residences has led the Chicago Master Steam Fitters' Association to adopt standards for computing boiler sizes and radiation quantities for buildings of average construction and for sizing low pressure steam mains, risers, branches, radiator connections, etc., on a one-pipe circuit system, dripped at end.

The main trouble with the ordinary installation in an apartment house and in many residences is that very few of such buildings can be heated to 70° F. when it is 10° below zero outside, and the rules for computing radiator quantities are designed to take care of that condition.

Radiation Rules.

Following is the schedule for computing minimum quantities of steam radiation at 70° F. with outside temperature at—10° F.:

One sq. ft. of radiation for every 300 cu. ft. of contents, plus 1 sq. ft. of radiation for every 15 sq. ft. net exposed wall surface, plus 1 sq. ft. of radiation for every 2 sq. ft. of glass surface.

For all rooms with plastered ceilings and unheated air space between ceiling and roof, add 1 sq. ft. of radiation to every 30 sq. ft. of ceiling area.

For all rooms with ceiling plastered on roof joist, add 1 sq. ft. of radiation to every 20 sq. ft. of ceiling area.

For all rooms with ceiling of open joist or concrete roof construction, add 1 sq. ft. of radiation to each 10 sq. ft. of roof.

For all rooms with northeast or northwest exposures add 10% additional radiation.

Where radiators are placed under seats or behind grills, add 20% additional radiation.

Where radiators are placed in open recesses, add 10% additional radiation.

For indirect radiation, add 50% additional.

For direct-indirect without fan system, add 25% additional radiation.

In measuring glass surface the full opening in wall shall be figured. Outside door openings shall be taken as glass.

For computing minimum quantities of hot water radiation at 70° F. with outside temperature at minus 10° F., add 60% to amount necessary for steam.

For computing minimum quantities for vapor systems at 70° F. with outside temperature at minus 10° F., add 20% to amount necessary for steam.

VAPOR SYSTEMS.

A vapor system is defined as a two-pipe steam system which has the return lines open to atmosphere with no valve at the return connections of heating units which will close against steam.

For heating to temperatures other than minus 10° F. to 70° F. multiply above quantities by the following co-efficients:

—10° to 65°	0.94
—10° to 60°	0.87
—10° to 55°	0.81
—10° to 50°	0.75
—10° to 45°	0.69
—10° to 40°	0.62

HOT BLAST COILS.

For computing boiler sizes to be used for hot blast coils, use manufacturers' condensation charts and figure ¼ lb. of condensation per hour as equivalent to 1 sq. ft. of direct radiation.

The above schedules of quantities are commensurate with good heating results for the average building of average construction, but by no means to be construed as guarantees of the proper quantities of radiation necessary to heat every building, as extraordinary conditions will of course require additional radiation.

RULE FOR COMPUTING BOILER SIZES.

Schedule for computing minimum sizes of boilers for the average building based on ratings specified in the manufacturer's catalogue issued previous to March, 1916.

Cast Iron Up-Draft Boilers—Size of boiler should be 80% greater than the actual amount of radiation in radiators and coils. See †.

Cast Iron Down-Draft Boilers—Size of boiler should be 60% greater than the actual amount of radiation in radiators and coils. See †.

Steel Firebox, Brick Set, Up-Draft Boilers—Size of boiler should be 35% greater than the actual amount of radiation in radiators and coils. See †.

Steel Firebox Brick Set, Up Draft with approved Furnace—To be figured on same basis as steel down draft of similar number.

Steel Firebox, Brick Set or Portable, Down-

Draft Boilers—Size of boiler should be 40% greater than the actual amount of radiation in radiators and coils. See †.

Cast Iron Magazine Type—Size of boiler shall be 60% greater than the actual amount of radiation in radiators and coils.

Steam Main Sizes.

The sizes of low pressure steam mains, one-pipe circuit system, dripped at end, as recommended by the association, are as follows:

Amount of Radiation, Sq. Ft.	Size Main Required, In. Diam.
Up to 60	1
60–100	1 ¼
100–200	1 ½
200–400	2
400–600	2 ½
600–900	3
900–1400	3 ½
1400–2000	4
2000–2600	4 ½
2600–3300	5
3300–4500	6
4500–7000	7
7000–9000	8
9000–11000	9
11000–15000	10
15000–24000	12

On all piping, proper provisions shall be made for expansion and contraction.

All piping shall be properly pitched.

All horizontal branches more than 12 ft. in length shall be increased 2 sizes.

All horizontal branches more than 16 ft. in length shall be properly dripped.

Supply mains shall not be reduced more than one-half the diameter of the largest main.

Dry returns shall be not less than one-half the diameter of the supply.

Wet returns may be one size smaller than one-half the diameter of the supply pipe. By supply pipe is meant the size of main at the point of leaving boiler.

† Where coils are to be inserted in boiler for heating water for domestic purposes, size of boiler should be increased, figuring each gallon of water tank capacity as equivalent to 2 sq. ft. of radiation. For example, a 160-gal. tank should be figured as equivalent to 320 sq. ft. of radiation. If this is connected to an up-draft cast-iron boiler, the increased size of the boiler would be 320 plus 80% or 576 sq. ft. If connected to a firebox up-draft boiler, increased size of boiler should be 320 plus 35% or 432 sq. ft.

Up-Feed Risers and Radiator Connections.

The following pipe sizes are recommended for up-feed risers:

Amount of Radiation, Sq. Ft.	Size Riser Required, In. Diam.
Up to 25	1
25–60	1 ¼
60–100	1 ½
100–200	2
200–350	2 ½
350–900	3
900–1200	3 ½
1200–2000	4
RADIATOR CONNECTIONS.	
Up to 25	1
25–60	1 ¼
60–90	1 ½
Above 90	2

All horizontal connections to radiators shall be increased one size, except branches for radiators from 91 to 130 sq. ft., which may be the same size as radiator connections.

All horizontal connections to risers shall be increased one size.

The Difference Between an Engine Horse Power and a Boiler Horse Power.

There is a decided difference between an ordinary horse power and a boiler horse power. A boiler horse power is more than 13 times as great as an engine horse power The definition of a boiler horse power is given as "the amount of heat required to evaporate 34.5 lbs. of water from and at 212° F. per hour." It has been figured that this amount of heat is equal to 33,479 B.T.U. per hour.

An ordinary engine horse power is equal to 33,000 foot-pounds per minute. Since it takes 778 foot-pounds to make 1 B.T.U., one can easily figure that an ordinary horse power is equal to 2,546 B.T.U. per hour.

We are now ready to find the relation by dividing as follows: 33,479 ÷ 2,546 = 13.149. Roughly speaking, therefore, the engine horse power is only one-thirteenth as great as the boiler horse power.—*W. F. Schaphorst.*

A recent instance of the appointment of an engineer to a town school board is reported from Gary, Ind., where A. R. McArthur, an engineer of that place, has recently received such an appointment. The Gary schools have a reputation as the originators of the "model school system."

LEGAL DECISIONS

Competing Companies.

The fact that a light, heat, and power company has secured the consent of borough authorities to the use of the borough streets does not, the Pennsylvania Superior Court holds, Relief Electric Light, Heat & Power Co.'s Petition, 63 Pa. Sup. Ct., 1, relieve it from the necessity of securing a certificate of public convenience from the Public Service Commission; and if such certificate is denied it cannot complain that it has been deprived of its property without due process of law, or that the order of the Commission is an impairment of the obligation of a contract. In supplying the service the petitioning company would compete with the West Penn Lighting Company, a Pennsylvania corporation, which had served the borough for a number of years and which intervened. It appeared that this company was serving the borough satisfactorily and at reasonable rates, and, therefore, an order of the Commission refusing the petitioner a certificate of convenience to occupy the streets was sustained although the borough authorities had consented to such use of the streets.

Suits on Contracts.

A manufacturer of ranges and stoves sold to its agent goods which he subsequently sold to a building contractor. The latter entered into a contract with an owner to complete the building in process of construction free from mechanics' liens and save the contractor harmless from all liens and material. In an action by the manufacturer the Illinois Appellate Court held that the contract was for the benefit of the manufacturer and entitled him to sue and recover thereunder. Whitcomb vs. Seney, 199 Ill. App., 526.

Review of Assessments by Courts.

When a public service corporation, or other taxpayer goes before a board of equalization to protest against an alleged excessive assessment made by the assessor, the burden is held to be on it to point out in what particulars the assessor made an excessive assessment, and it must give to the board full and truthful information touching all matters that will enable it to arrive at a correct valuation of the property, and show by convincing evidence that the assessment made by the assessor was excessive, and why and in what respects. On the other hand, the board should also on request furnish to the taxpayer the facts and figures on which it proposes to estimate the value of the franchise and information as to the method by which it arrived at its conclusion, so that the taxpayer may be prepared to challenge the facts and figures as well as the conclusion reached by the board. The state and cities are only entitled to a just and fair assessment according to constitutional standards and limitations, and to get at this result the board is entitled to full and truthful information from the taxpayer, and the taxpayer has the right to have the board furnish him with the facts, figures, and methods by which it estimates the value of the franchises involved. Kentucky Heating Co. vs. Louisville, Kentucky Court of Appeals, 192 S. W., 4.

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Difference Between Initial and Normal Heating of a Radiator.

By H. S.

It is surprising how great the difference is in the amount of steam necessary to heat up a radiator and the amount necessary to keep it warm, after it is once heated. The average radiator, of the steam type, weighs about 6½ lbs. per square foot. A 100-sq. ft. radiator would therefore weigh 650 lbs. Assume the room in which the radiator is located to be at a temperature of 50° F., which is about the usual temperature. The temperature of the steam, assuming the pressure to be 2 lbs., would be 220° F. Thus the difference in temperature between the steam and the room is 170°.

The specific heat of cast-iron is 0.13. Therefore, $650 \times 170 \times 0.13 = 14{,}365$ B.T.U., which is the total amount of heat necessary for the initial heating of the radiator. Dividing 14,365 B.T.U. by 961, the latent heat of steam at 2 lbs. pressure, the result is 14.94, the pounds of steam required for the initial heating of the radiator. An ordinary steam radiator, with the proper size steam connection, will heat up in 15 min. as a maximum length of time.

After the radiator is heated it will require 14-lb. per square foot per hour for the normal heating, provided the room is kept at a temperature of 70° F. Therefore, a 100-sq. ft. radiator will require 25 lbs. of steam per hour for the normal heating. For a period of 15 minutes this radiator will require 6¼ lbs. of steam for the normal heating.

It can readily be seen that about 2½ times as much steam is required for the initial heating than is required for the normal heating of the radiator during the same period of time. If the temperature of the room to be heated is lower than 50°, the amount of steam for initial heating will be larger in proportion.

CORRESPONDENCE

Basis for Figuring Condensation in Steam Heating Systems Per Year.

EDITOR HEATING AND VENTILATING MAGAZINE:

Will you kindly advise us what you estimate the number of pounds of condensation is per year in steam heating systems? Also does this include the condensation in the service lines in the streets and, if not, what percentage do you allow for line loss?

Greenville, Pa. C.

The amount of steam used per square foot of radiation per year is an extremely variable quantity depending upon the season, the use of a meter, and the building in which the service is rendered. Where heating installations have been metered it has been found to be in the neighborhood of 500 lbs. per annum, but where unmetered service is installed it is quite likely to run much higher. In fact, in the locality of New York it is usual to allow 100 lbs. of coal per annum, which at 8,000 B. T. U. per pound of coal, is equal to 800,000 B. T. U. supplied inside of the building; and, at approximately 1,000 B. T. U. per pound of condensation, this would represent about 800 lbs. per square foot per season. Another district heating company allows ⅓ lb. per square foot per hour for the connected load as a maximum service and since each square foot of radiator surface condenses about ¼ lb., this leaves a balance of 0.08 ⅓ lbs. per square foot for line loss, although part of this takes place inside of the building.

Figuring Heater Sizes for Hot Water House Service.

EDITOR HEATING AND VENTILATING MAGAZINE:

We are installing a heating plant in a small building where our boiler capacity must be kept down owing to lack of space in the boiler room. The job also includes hot water equipment to "raise 500 gal. of water from 50° to 150° F. per hour," the water being heated by steam. We have found out that the water will probably all be used for washing up in a period of about 15 minutes with 4 hours interval between times of using.

Can you recommend a rule by which the capacities of various cast-iron heating boilers rated in different ways may be reduced to a comparable and reasonably exact basis and also suggests whether a hot water storage heater or a steam heater of instantaneous type —which would be much cheaper for us— would allow us to use a boiler of smaller capacity and help us out in the matter of space in the boiler room. R. L.

Our correspondent can fulfill the letter of his contract by supplying hot water at the rate of 500 ÷ 60 = 8⅓ gal. per minute, the heating of which would require roughly 8⅓ lbs. of steam per minute regardless of whether an instantaneous or storage type of heater be used. Every gallon of water raised 100° F. requires approximately 1 lb. of steam at 5 lbs. pressure which is shown by the following:

1 gal. = 8⅓ lbs. of water.

8⅓ lbs. @ 100° rise = 833 B. T. U.

Radiation and pipe losses, 20%.

833 + 20% of 833 = 833 + 166 = 999 B. T. U.

1 lb. of steam at 5 lbs. = latent heat of 961 B. T. U.

Owing to the conditions requiring the use of 500 gal. in 15 minutes we would advise the use of the storage heater *to give satisfaction* and not because of any requirement in the contract. An instantaneous heater to supply 500 gal. in 15 minutes would take a heater rated at $500 \times \frac{60}{15}$ or 2000 gal. per hour, which also means steam at the rate of 2000 lbs. per hour or 2000 × 4 = 8000 sq. ft. increase in boiler rating for hot water alone.

On the other hand, with a storage heater and four hours between periods of use it would be entirely practical to put in a heater with a heating capacity of 500 ÷ 4 or 125 gal. per hour or 125 lbs. of steam, resulting in an increase of boiler rating for hot water of only 125 × 4 = 500 sq. ft.

The storage capacity of the storage heater should be made one-third more than the amount used at the end of each period or

$$500 + \tfrac{1}{3} \text{ of } 500 =$$

$$500 + 167 = 667 \text{ gal.}$$

Therefore a 700-gal. storage heater with a heating capacity of 125 gal. per hour would produce the smallest load on the steam boiler and an instantaneous steam heater would produce the greatest load. As far as cost goes, the reduction in the size of the steam boiler and the size of steam pipe and valves for the storage heater will more than counterbalance the additional cost of the storage heater.

In regard to checking the sizes of cast-iron steam boilers, it has always been found that the grate area has a great deal to do with the amount of steam produced. It is easily possible to get double the rating out of the same boiler when the grate area is doubled or when the draft is increased so as to burn double the quantity of coal.

Even with natural draft and frequent attention we do not believe it is wise to exceed a combustion rate of 10 lbs. of coal per square foot per hour which at 8000 B. T. U. turned into steam gives a rating of $8000 \times 10 \div 250 = 320$ sq. ft. per square foot of grate surface. This method will give a pretty good check on any cast-iron heating boiler although for residence work not over 6 or 7 lbs. of coal per square foot of grate per hour should be figured.

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A Correction.

In the article in The Heating and Ventilating Magazine for May, 1917, on "Recent Progress in the Use of Gas for House Heating," it was mentioned that the compilation of the data presented in the article had been made by a committee on auxiliary heating appointed by the American Gas Institute. It should be stated that this compilation was made by the committee on auxiliary heating of the National Commercial Gas Association.

In a letter calling attention to this error, George A. Barrows, chairman of that committee states: "There is a committee of the American Gas Institute on house heating, of which Mr. C. C. Winterstein, of the United Gas Improvement Company, of Philadelphia, is chairman. These two committees are co-operating, the committee of the American Gas Institute studying particularly the engineering questions while the committee of the National Commercial Gas Association is paying particular attention to the commercial questions."

In this connection attention is called to the article on "Manufactured Gas for House Heating," by George S. Barrows and C. C. Winterstein, in the March, 1917, issue.

A Residence Without a Chimney.

A building without a chimney and supplied by one company with steam for heating, electricity for light and power, gas for cooking and water for domestic purposes is shown in the accompanying illustration. It is located in Excelsior Springs, Mo., being known as the Ligon Apartments. The building has a full cement basement which has storage lockers belonging to each apartment. It is constructed of red cherry-colored brick, trimmed with stone trimmings and is divided into twelve apartments, each having large closets and private baths. The apartments are furnished with the latest improved combination furniture, all beds being of the disappearing type, leaving a maximum amount of room space during the day time.

The steam for heating is furnished through underground mains and this, as well as the other services mentioned, are supplied by the Excelsior Springs Water, Gas and Electric Company. The building is piped for the American District Steam Company's Atmospheric system.

In place of the chimney there are small openings in the wall about 4 in. square, for taking away the fumes from the gas stoves. No provision is made at all for any other fire.

LIGON APARTMENTS, EXCELSIOR SPRINGS, MO., BUILT WITHOUT A CHIMNEY

When the building was being constructed the owner was advised to put in a flue for emergency purposes. His reply was that he was satisfied something would happen to his building before it did to the company's plant. It was figured that he saved from 10% to 12% on insurance by leaving out all suggestions of furnace or fire-places.

A 500-gal. tank, fitted with steam coils for furnishing hot water to the building is located in the basement. The heating system and the hot water tank are on separate valves so that either may be operated at any time independently of the other. It should be mentioned that the company keeps steam on its mains the year round and has thereby connected a fairly good-sized load during the summer months for heating water in the hotels, bath houses, apartment houses and barber shops.

The Excelsior Springs Water, Gas & Electric plant was first put in operation in 1912. Last winter it had 68 service connections, two of which have 10,000 sq ft. each of radiation connected. The company states that not a single customer has quit taking the service after being connected to the system.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Arrangements for Summer Meeting.

The Illinois Chapter, through a committee composed of J. A. Cutler, chairman; Benjamin Nelson, E. J. Claffey and August Kehm, is busily engaged in the preparation of the local details for the forthcoming meeting of The American Society of Heating and Ventilating Engineers, in Chicago, July 18-20. The government, it is announced, will furnish a large part of the programme through authorized representatives of both the army and navy. Also, features of engineering interest are being arranged for locally, and a special entertainment programme is being arranged for the ladies. Headquarters will be at the LaSalle Hotel.

Kansas City Chapter Takes Up Mechanical Blast Systems of Heating.

Mechanical blast systems of heating were discussed at length before the Kansas City Chapter at its June meeting, held at the Coates House. The meeting was preceded by a chapter dinner. The subject for discussion was divided into three parts: 1.—the design of air washers and ducts; 2.—design of fans and driving mechanism of same; and 3.—the mechanical installation.

Mr. Waddington discussed the development of air washers and stated the first apparatus used to filter air was an ordinary cotton screen. This was succeeded by the coke air washer, in which air was passed through a bed of ordinary coke, which was kept wet with moisture. The coke washer was succeeded by the rain type of washer, where the air passed through a sheet of water, and this type was succeeded in turn by the mist type, in which air passed through a chamber of fine water mist after which it passed through eliminator blades and over scrubbing surfaces, which effectively removed the excess water and dirt.

A modern development of the air washer has been in its use to humidify, as well as to clean the air, and also for use as a cooling medium.

Ducts, he said, should be designed with velocities about as follows:

Fresh air	600 to 1,000	ft. per minute
Tempering coils	900 to 1,200	" " "
Main Ducts	900 to 2,000	" " "
Laterals	900 to 1,200	" " "
Risers	600 to 800	" " "
Registers	300 to 500	" " "

Mr. MacMorran, in discussing the design of fans and driving mechanism, defined tip speed as the velocity of the periphery of the wheel. Static pressure is pressure due to resistance and more properly could be defined as maintained resistance. A propeller or disc type of fan is suitable for low resistance, and with a fan having 1,200 ft. velocity of air through the fan with a free delivery, under a ½-in. static pressure, the velocity would be only 400 to 600 ft. A tip speed of 5,000 ft. or approximately a mile a minute is the maximum for this type of fan. It is better to have a tip speed about 2,500 ft. per minute, but this speed would overcome only a low static pressure. The H. P. increases directly with the resistance, which is opposite to that found in housed fans of the steel plate or multiblade type.

Cased or steel-plate fans show greater efficiency and are more suitable for work under static pressures of around ½-in. and above.

The multiblade type of fan of equal capacity should be operated at about 50% greater speed than the steel plate fan, but the power required to drive a multiblade fan is about 60% that required for a steel-plate fan. Multiblade fans thus take about 15% to 20% less space and require less power than the steel-plate fans of equal size. The advisable tip speed is around 2,900 to 3,000 ft. per minute. Mr. McMorran also stated it was cheaper to drive the fan by engine than by motor, as the exhaust steam from the engine could be sent through the coils and hence the only cost would be that in generating steam at about 25 lbs. pressure, rather than 2 or 3 lbs. pressure.

Mr. McIntyre spoke of the mechanical installation and stated that the main thing to be guarded was to have proper supports for the coils. He advocated reinforced concrete for this purpose. The proper venting of coils was necessary for efficient service and in his opinion 50% of the coils are not properly vented. The arrangement of the steam supply should be such that each coil would get an adequate amount of steam under all conditions and particularly the outside coil, which has the heaviest duty. The returns from the coils should be separate and so arranged that one coil return could not stop another. He also stated that it was his experience that a good pump and receiver was a great help to a mechanical blast job.

The Kansas City Chapter it was reported, now has about thirty members, with a dozen applications on file. Nine members expressed their intention of attending the summer meeting of the society in Chicago, July 18-20.

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National Warm Air Heating and Ventilating Association.

New officers were elected at the annual meeting of the National Warm Air Heating and Ventilating Association, which met in Cleveland, O., June 13. For president, D. Rait Richardson, of New York, succeeds John D. Green, who asked to be released from further duties as president. Mr. Green was made an honorary member of the executive committee. The other new officers are: Vice-president, W. G. Wise, Akron, O.; secretary, Allen W. Williams, Columbus, O. (re-elected); treasurer, Irving L. Jones, Utica, N. Y. Executive committee: E. P. Miller, W. L. Dawborn and George L. Wilkinson. One of the most important actions taken was the discontinuance, for the present, of the association's advertising campaign, one reason being that the trade will take all the warm-air furnaces that can be produced this year.

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New Books.

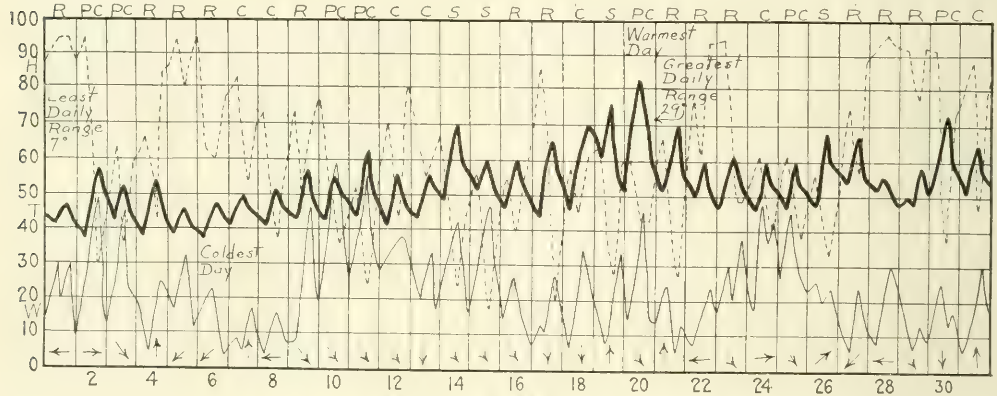
VENTILATION LAWS IN THE UNITED STATES, third edition, containing also the board of health requirements and the regulations of the National Board of Fire Underwriters, together with the model ventilation requirements as promulgated by The American Society of Heating and Ventilating Engineers, has recently been published by the Heating and Ventilating Magazine Company, New York. The volume, with its 178 pages of text, shows in a striking manner, the advance of compulsory ventilation laws, as well as the need for a new compilation. Minnesota, for instance, has adopted a remarkably complete code for school buildings. Indiana has revised its code, as has also New Jersey and Vermont. These and other changes, such as the revision of the Illinois School law and of the Massachusetts building inspection law, are presented in comprehensive abstracts, together with a carefully-compiled abstract of the exhaustive Ohio building code, as far as enacted. A section is given over to the laws regarding the heating and ventilating of industrial buildings, recent revisions being included of the requirements in Tennessee, Illinois, Kansas and New York. The latter takes in the recent rulings of the New York Industrial Commission, made since the enactment of the law, bearing on the matters of heating and ventilation. Finally, the model requirements set forth by The American Society of Heating and Ventilating Engineers, are presented in revised form, supplemented by "General Notes Inserted by the Council" which did not appear in the society's first publication. Size 4 × 6 in.

POWER PLANTS AND REFRIGERATION, being Volume 2 of the important work on "Mechanical Equipment of Buildings," by Louis A. Harding and Arthur C. Willard, has made its appearance and bears out the hopes, to a marked degree, of those who had been awaiting its publication. In order to make the volume more complete, several of the chapters appearing in Volume 1 have been reprinted, including the chapters on heat; water, steam and air; and fuels and combustion. The new volume is modeled on the same broad lines as Volume 1. Manufacturers' data, which have been found useful and reliable, are presented in detail, supplementing the authors' own voluminous data. Special mention should be made of the chapter on "Chimneys for Power Boilers," which is remarkably complete, and also the chapter on "Power Plant Piping." An entire chapter is given over to the "Arrangement of Steam Power Plants," embracing typical layouts in some fifteen different institutions. Other important chapters are those on boilers and rules for construction, mechanical stokers, superheaters and economizers, mechanical draft, feed-water heaters and feed-water purification, steam engines, steam turbines, pumps, steam condensers, cooling ponds and towers, coal and ash-handling machinery, and isolated power plant data. Under refrigeration chapters are presented on units employed in refrigeration practice, heat transmission and construction of cold storage walls, methods of producing artificial refrigeration, cold air, compression and vacuum machines; ammonia condensers, brine circulation system, the ammonia absorption machine and ice-manufacturing plants, including details of a notable installation. Size 7 × 9½ in. Pp. 766, with 496 illustrations, including nine double-page inserts. Bound in flexible leather. Price $5.00. Published by John Wiley & Sons, Inc., New York, or may be had through the book department of THE HEATING AND VENTILATING MAGAZINE.

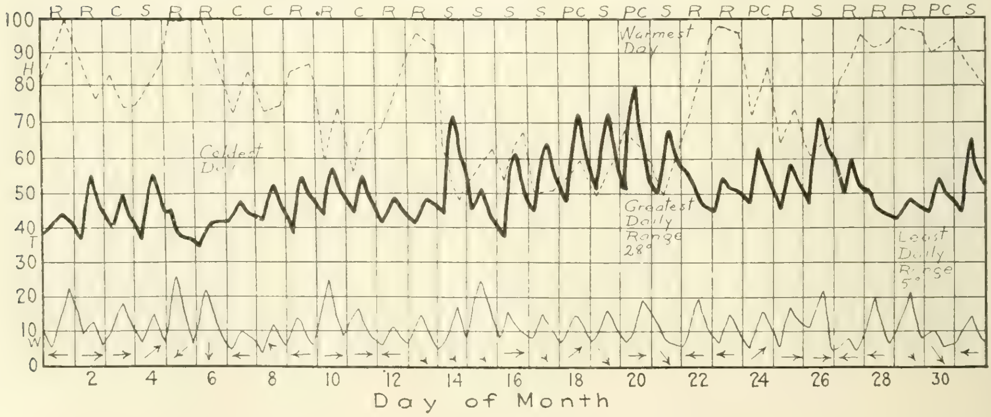
The Weather for May, 1917

	New York	Boston	Pittsburgh	Chicago	St. Louis
Least daily range, degrees F	82	80	83	88	90
Date of highest temperature	20	20	19	19	19
Lowest temperature, degrees F	38	36	36	37	38
Date of lowest temperature	6	6	3	23	5
Greatest daily range, degrees F	29	28	32	27	26
Date of greatest daily range	20	20	30	29	26
Least daily range, degrees F	7	5	6	5	5
Date of least daily range	1	29	9	11	3
Mean temp. for month, degrees F	53*	51	55*	52.6	60.6
Normal mean temp. for month, degrees F	59.3	56.6	62.6	56.5	66.5
Total rainfall, inches	3.29	4.45	2.65	3.41	3.78
Total snowfall, inches					
Normal precipitation, this month, in.	3.18	3.51	3.30	3.37	4.24
Total wind movement, miles	13753	8303	9685	10101	9917
Average hourly wind velocity	18.5	11.2	13	13.6	13.3
Number of clear days	4	9	4	12	9
Number of partly cloudy days	10	5	4	7	15
Number of cloudy days	17	17	23	12	7
Number of days on which rain fell	18	14	16	16	12
Number of days on which snow fell					
Snow on ground at end of month, in.					

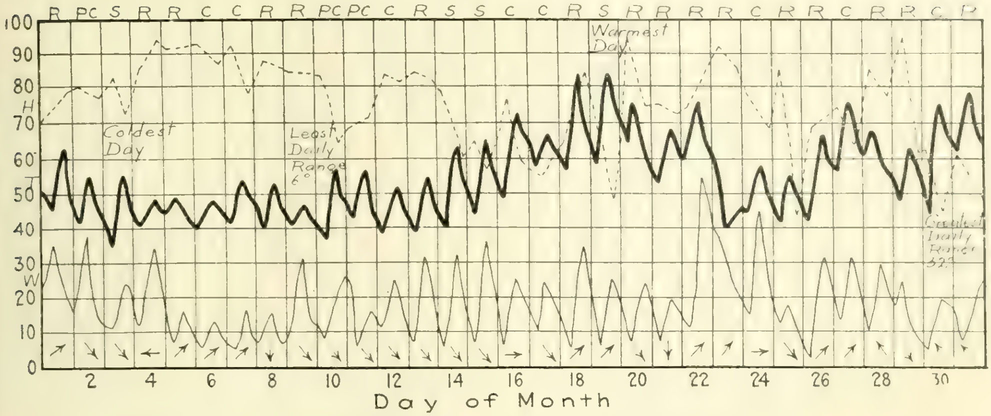
* The mean temperature was the lowest ever recorded by the U. S. Weather Bureau for this month.



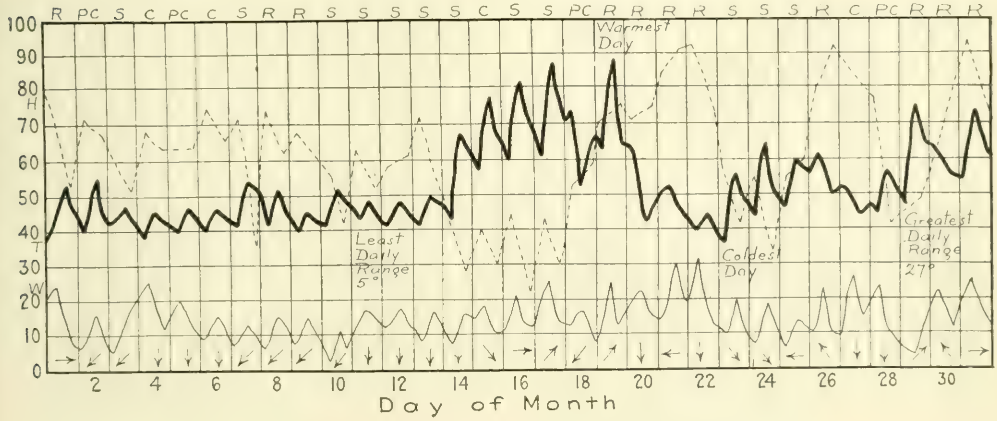
RECORD OF THE WEATHER IN NEW YORK FOR MAY, 1917
(Hourly Observations of the Relative Humidity Are Recorded on this Chart.)



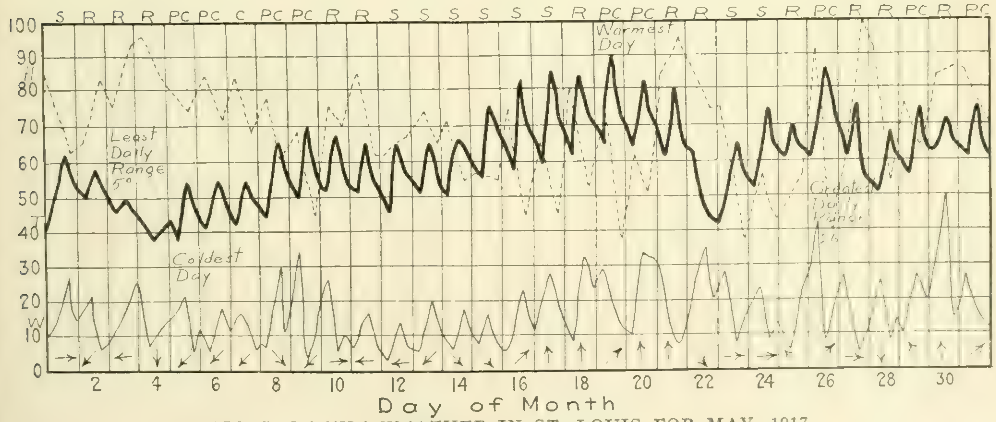
RECORD OF THE WEATHER IN BOSTON FOR MAY, 1917



RECORD OF THE WEATHER IN PITTSBURGH FOR MAY, 1917



RECORD OF THE WEATHER IN CHICAGO FOR MAY, 1917



RECORD OF THE WEATHER IN ST. LOUIS FOR MAY, 1917

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

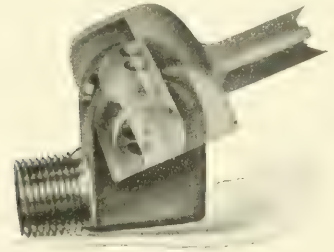
Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

Trade Literature.

Guaranteed Corliss Valve Steam Trap of the constant-flow type, for every condensation removal service, is featured in a new circular issued by the Plant Engineering & Equipment Co., Inc., New York. On the basis that no trap is better than its valve, special attention is paid to the Corliss valve feature of this trap which prevents the valve from drawing away from its seat, so that there is no wiredrawing or similar trouble. The condensation, however, has a free, unobstructed passage through the valve, and by its rotary or shearing action, the seat is wiped clear of obstructions at each closing. This trap is built for vacuum service and for pressures up to 300 lbs. The circular includes tables of capacities, etc. Size 6 × 9 in. (standard). Pp. 4.



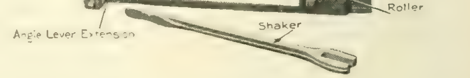
CONSTRUCTION OF VALVE FOR CORLISS VALVE STEAM TRAP.

First House-Heating Boiler Improvement in Fifteen Years is the way a recent bulletin of the National Radiator Co., Johnstown, Pa., describes the three-piece fire-pot of the National Novus boilers. Being made in three pieces, the walls are an even ¼-in. metal thickness, top and bottom, which, it is claimed, means quicker heat at a substantial fuel saving. The rectangular shape, it is added, exposes fully 10% more surface to the fire than other types. The bulletin contains a notable facsimile letter containing the testimony of practical men to the quality and fair business treatment which they have received for nearly a quarter of a century of dealings with the National Radiator Company.

Parker Sash Chain, made by the Parker Supply Co., New York, from a special temered, cold rolled steel, is brought to the attention of the trade in a newly-issued circular. The full tensile strength of the steel is given to the links by punching them along the grain of the metal. The chain is wound on steel spools made by the Parker compan Each spool contains 500 ft., the standard unit in which this product is sold. The finish varies from bright steel to red metal and brass.

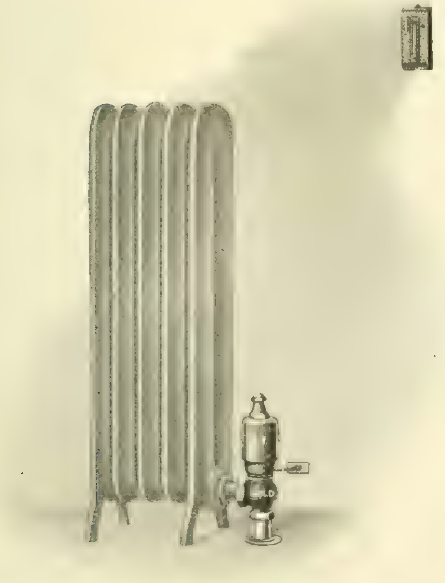
Columbian Vises and Anvils, made by the Columbian Hardware Co., Cleveland, O., are covered in a new catalogue issued by this company. The products includes combination pipe vises, with stationary or swivel bases; hand vises and several types of machinists' vises. Size 6 × 9 in. (standard). Pp. 36.

International Economy Boilers are a new product of the International Heater Co., Utica, N. Y., illustrated and described in a newly-issued catalogue devoted exclusively to this line. These boilers are of the round type and have been put out after a period of rigid tests and investigations covering more than two years. The name "Economy" was chosen because of the efficiency shown throughout the tests. These boilers are made in fifteen sizes, with four different diameters of grate, and they are equipped with the new patented Economy every-motion grate. Emphasis is laid on their large coal capacity as well as on their high evaporative power, resulting in a long firing-period of from 8 to 12 hrs. The boilers are so designed that the water circulation is positive and the flue passages are arranged so that short-circuiting in passing through the boiler is prevented. The "every-motion" grate used with this boiler is found to be equally suitable for all kinds of fuel and operates to clear the fire from the extreme outer edge to the center. It is hung in a drop frame which can be unlatched and the contents of the fire dropped. In shaking the grate the outer rim revolves and at the same time the center bars are agitated with a rocking motion. Any bar can be lifted out or dropped into position without disturbing any other portion of the grate. Size 6¾ × 9¾ in. Pp. 8.



EVERYMOTION GRATE USED IN INTERNATIONAL ECONOMY BOILER.

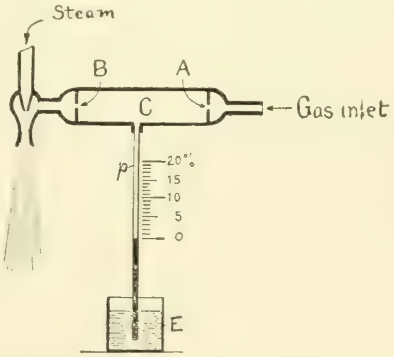
Gold's Thermostatic Heat Regulating System, for regulating the temperature in buildings, and operated entirely by electricity from the lighting circuit, is illustrated and described in a newly-issued circular received from the Gold Car Heating & Lighting Co., New York. The fact that this method uses no compressed air is emphasized. The system consists of two devices, an electric thermostat, operating contacts by the expansion and contraction of a temperature-sensitive diaphragm, placed on the wall of a room, and a special electro-magnetic valve, which takes the place of the ordinary inlet valve on the radiator. One thermostat, it is noted, will control a number of radiators. The valve and thermostat are connected by electric wires and the operating current taken from the lighting circuit. A volatile liquid sealed in the diaphragm of the thermostat, expanding and contracting with variations in the temperature, actuates a metal strip, thereby opening or closing the electric circuit, as the case may be. Size 3¼ × 6 in. Pp. 8.



APPLICATION OF GOLD ELECTRO-MAGNETIC VALVE TO RADIATOR.

Kewanee Firebox Boilers are the subject of a new catalogue, No. 70, which the Kewanee Boiler Co., the manufacturers state, supersedes everything previously issued pertaining to this line. Special attention is directed to the fact that all Kewanee boilers are now built according to the rules of construction adopted by the A. S. M. E., although slight changes have been made in the details of construction of some Kewanee boilers to make them conform with what has now been accepted as the proper method of building steel boilers. These boilers are regularly constructed for working pressures not exceeding 15 lbs., but those built in accordance with the A. S. M. E. Code are designed for working pressure of from 15 to 100 lbs. The manufacturers, the Kewanee Boiler Co., Kewanee, Ill., state that they have in their yards at present a large stock of boilers and a considerable tonnage from which they can build any sizes not in stock. The catalogue, which contains, as usual, complete data for both the brick-set and portable types, is published on the occasion of the 25th anniversary of the founding of the company. Size 6 × 9 in. (standard). Pp. 32.

Uehling CO_2 Meter, which makes a continuous, rather than intermittent, record of the CO_2 in the flue gases, is the subject of a well-prepared circular issued by the Uehling Instrument Co., Passaic, N. J. The principle of the machine is first described, this being based on the change in pressure, due to a change in volume, in a stream of gas flowing through two apertures. By reducng the gas volume, for instance, between two apertures, A and B, as shown in the accompanying illustration, by absorbing the CO_2 content, a change of pressure is caused in Chamber C which is transmitted to suitable manometer tubes and recorders calibrated in per cent CO_2. By the application of this fundamental principle in a practical apparatus, it is pointed out, all moving parts, such as motors, counter-weights, etc., are eliminated. The machine proper consists essentially of a cast-iron header and wrought-iron cylindrical regulator, on which are mounted the necessary filters, absorption chamber and the adjusting cocks. Size 6 × 9 in. (standard). Pp. 4.



PRINCIPLE OF UEHLING CO_2 METER.

Standard Heating and Ventilating Data Sheets.

Previously-published data sheets, similar to those appearing in this issue, are as follows:

February, 1917, Issue.

No. 1—B.T.U. Losses.
No. 1-A—B.T.U. Losses—Brick.
No. 1-B—B.T.U. Losses—Stone and Concrete.
No. 1-C—B.T.U. Losses—Combinations.

March, 1917, Issue.

No. 1-D—B.T.U. Losses—Tile.
No. 1-E—B.T.U. Losses—Frame Construction.
No. 1-F—B.T.U. Losses—Glass, Skylight and Miscellaneous.
No. 1-G—B.T.U. Losses—Ceiling, Floor and Roof.

April, 1917, Issue.

No. 2—Exposure.
No. 3—Leakage.
No. 4—Temperature Range.
No. 4-A—Temperature Range.

May, 1917, Issue.

No. 5—Computing Heat Losses.
No. 6—B.T.U. Example of Computation.
No. 7—Ventilation.
No. 8—Air Changes—Churches and Theatres.

June, 1917, Issue.

No. 8-A—Air Changes—Hospitals.
No. 8-B—Air Changes—Hotels and Libraries.
No. 8-C—Air Changes—Schools.
No. 8-D—Air Change—Miscellaneous.

Copies of these sheets, printed separately on one side only, may be obtained at 5 cents each. The attention of readers is also called to the special binder furnished by the Heating and Ventilating Magazine Company for holding these sheets. The price of these binders, bound in brown duck, with strong spring clasp, is $1.00, post paid.

Readers will kindly take notice that the sheets will not always appear consecutively numbered. For instance, where a large number of sheets, such as those on radiators, fall under the same key number, they will be interspersed with sheets on other subjects. The complete series, however, will have each subject listed under its proper number.

Erratum—Sheet No. 8-A, in the June issue on "Air Changes—Hotels and Libraries" should be No. 8-B.

Deaths

Sidney R. Sheldon, vice-president and chief engineer of Sheldons, Ltd., Galt, Ont., died at his home in Galt, May 7.

James M. Johnson, treasurer of James B. Clow & Sons, Chicago, died at his home in that city, June 10. Mr. Johnson was 69 years old and had been ill several months. He had been identified with the Clow company since 1885.

William W. Green, president of the Garden City Fan Co., Chicago, died in Niles, Mich., June 2. He was 79 years old. The immediate cause of death was uraemic poisoning, although he had long been confined to his rooms. Mr. Green was born in Williamstown, Mass. He came to Chicago in 1882 and made that city his home until 1902 when the plant of the Garden City Fan Company, of which he was president and active manager, was moved to Niles. Since that time he divided his time between Niles and Chicago. Mr. Green's generosity was proverbial. He liked to entertain his friends, while his gifts of property in aid of relatives and, in some cases, of old friends, were many. He is survived by one sister and one son, Ed. Green, who will continue the management of the business. On the day of Mr. Green's funeral the business houses were closed between 10:30 and 11:30 a. m. at the request of Mayor Troost.

◆

National Association of Sheet Metal Contractors

National Association of Sheet Metal Contractors, which met in Cleveland, June 12, re-elected George Harms, of Peoria, Ill., as its next president. Attention was called in the president's address to the growing use of sheet metal in ventilating work and he urged the sheet metal contractor to get in closer touch with this field.

◆

Eastern Supply Association

Eastern Supply Association, which met in New York, June 20, was favored with an address by George D. McIlvaine, secretary of the National Pipe and Supply Association, on the subject of "How Can We Conserve a Reasonable Proportion of the Profits?" He urged closer co-operation between the manufacturers and the jobbers. He was followed by George H. Van Arnam who delivered an address on "Building Young Men for Business." At the afternoon session, Job E. Hedges spoke in a patriotic vein on "United States Before the World."

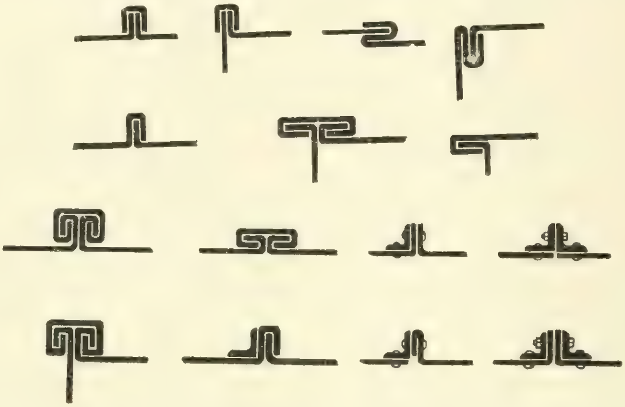
PROPERTIES OF AIR

Temperature Degrees F.	Vol. of Dry Air with Unity at 32° F.	Cubic Feet in 1 lb. of Air	Weight of 1 cu. ft. of Dry Air	Elastic Force of Vapor. in. of Mercury	Cubic Feet of Vapor from 1 lb. of Water	B.T.U. Absorbed by 1 cu. ft. of Air per Deg. F.		B.T.U. Absorbed by 1 cu. ft. of Air per Deg. F.	
						Dry Air	Sat. Air	Dry Air	Sat. Air
Zero	0.935	11.58	0.0864	0.044	......	0.02056	0.02054	48.5	48.7
12	0.960	11.87	0.0842	0.074	......	0.02004	0.02006	50.1	50.0
22	0.980	12.14	0.0824	0.118	......	0.01961	0.01963	51.1	51.0
32	1.000	12.40	0.0807	0.181	3289	0.01921	0.01924	52.0	51.8
42	1.020	12.64	0.0791	0.267	2252	0.01882	0.01884	53.2	52.8
52	1.041	12.88	0.0776	0.388	1595	0.01847	0.01848	54.0	53.8
60	1.057	12.93	0.0764	0.522	1227	0.01818	0.01822	55.0	54.6
62	1.061	13.13	0.0761	0.556	1135	0.01811	0.01812	55.2	54.7
70	1.078	13.34	0.0750	0.754	882	0.01777	0.01794	56.3	55.5
72	1.082	13.39	0.0747	0.785	819	0.01767	0.01790	56.5	55.8
82	1.102	13.64	0.0733	1.092	600	0.01744	0.01770	57.2	56.5
92	1.122	13.90	0.0720	1.501	444	0.01710	0.01751	58.5	57.1
100	1.139	13.95	0.0710	1.929	356	0.01690	0.01735	59.1	57.8
102	1.143	14.14	0.0707	2.036	334	0.01682	0.01731	59.5	57.8
112	1.163	14.40	0.0694	2.731	253	0.01651	0.01711	60.6	58.5
122	1.184	14.65	0.0682	3.621	194	0.01623	0.01691	61.7	59.1
132	1.204	14.90	0.0671	4.752	151	0.01596	0.01670	62.5	59.9
142	1.224	15.15	0.0660	6.165	118	0.01571	0.01652	63.7	60.6
152	1.245	15.40	0.0649	7.930	93.3	0.01544	0.01634	65.0	61.5
162	1.265	15.65	0.0638	10.099	74.5	0.01518	0.01616	66.2	62.4
172	1.285	15.90	0.0628	12.758	59.2	0.01494	0.01598	67.1	63.3
182	1.306	16.17	0.0618	15.960	48.6	0.01471	0.01580	68.0	64.2
192	1.326	16.42	0.0609	19.828	39.8	0.01449	....	68.9	.....
202	1.347	16.67	0.0600	24.450	32.7	0.01426	....	69.5	.....
212	1.367	16.92	0.0591	29.921	27.1	0.01406	....	71.4	.....

DUCT AND FLUE WORK.

Ducts and flues for heating and ventilating are usually constructed of galvanized iron or masonry. When galvanized iron is used they may be round or oblong in shape and are often built of No. 24 U. S. Gauge up to 350 sq. in. of area, No. 22 U. S. Gauge from 351 to 1200 sq. in. of area and No. 20 U. S. gauge above this, with suitable stiffners. Casings for heaters, fan connections, fresh air intakes and other large compartments are usually built of No. 18 U. S. gauge.

Ducts and flues are generally made in the shape of sections and joined up on the job, special connections being installed after the main lines are in place. There are various methods employed by different contractors for joining the various sections, some of the more common types being here illustrated. For smaller work the use of an angle iron is unnecessary, the standing seam giving all the stiffness required for short spans, but for spans over 4 ft.—and certainly for spans over 6 ft.—angle irons are most desirable.



Some engineers specify that ducts shall be stiffened "so as to bear the weight of a man on a plank laid along the top at any location selected." Flat seams are little used in good work unless the size of the pipe is 12 in. or less.

Round pipes, from a purely efficiency standpoint, are always the best, the amount of metal required to furnish a given amount of air at a given velocity being less and the friction or resistance to the passage of the air also being reduced. In factories, shops and other industrial buildings round ducts and flues are the rule; in better classes of buildings, where space is at a premium, square or rectangular flues are used almost exculsively. The length of the long side of a rectangular flue should never be more than twice the length of the short side unless absolutely unavoidable.

Volume dampers should be placed so as to control with absolute certainty the quantity of air delivered to each outlet or inlet and it is impractical to try to design a system where such dampers are not needed.

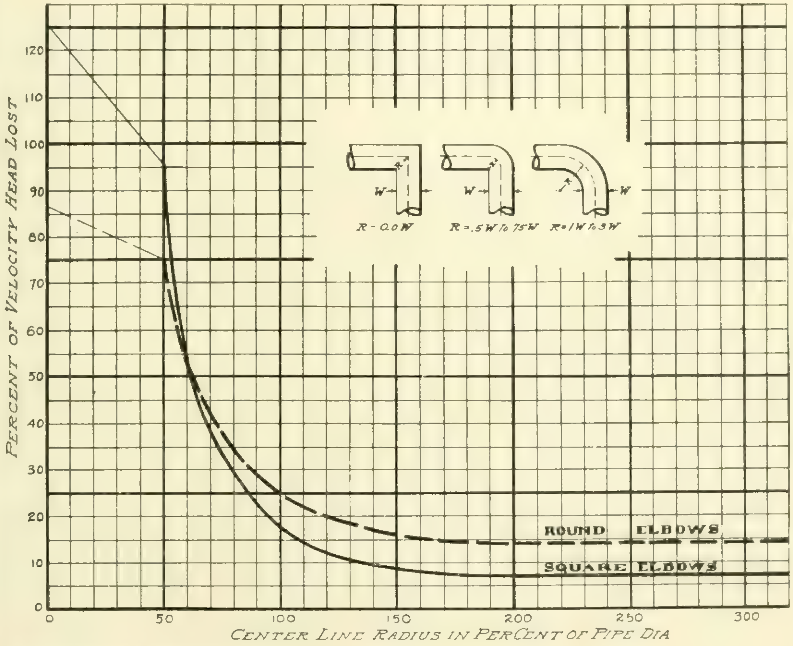
Ducts and flues may be sized by two different methods:

(*a*) By assuming velocities in the pipe (according to its position in the system) and calculating to find its area, or

(*b*) By assuming a proportional area of pipe to the area of the fan discharge and calculating all pipe areas on the basis of the equivalent number of 1-in. pipes.

ELBOWS AND BENDS

All bends and elbows should be made with a center line radius of not less than one and one-half times the width of the pipe and some prefer using two times the pipe width. Tests with elbows of various radii by Frank L. Busey and read before the A. S. H. & V. E. in 1913 indicate that the resistances vary as shown on the following curves. From these curves it can be seen that little is gained beyond one and one-half times the width and nothing at all beyond two times the width.



ANEMOMETER READINGS

The following is the method recommended by the committee appointed in 1913 by the A. S. H. & V. E. to investigate and recommend a standard method of obtaining anemometer readings of air velocities and quantities at supply and vent registers. The committee decided that all special apparatus, such as cones, plates, etc., was impractical and formulated seven rules as follows:

1. The opening shall be divided into equal rectangular areas, no side of which shall be over 10 in. long, excepting where this would require more than ten readings, in which case the opening shall be divided into twelve equal areas.
2. Readings are to be taken in every case at the center of every area.
3. Readings are to be one-half-minute duration, the anemometer being held at the register face or in the plane of the opening.
4. Where the diffusers are used, a total area is to be computed on the basis of the periphery of the diffuser.
5. The average of the readings are to be considered as the average velocity at the opening. Where negative velocities are found, they are to be deducted in arriving at the average velocity.
6. In computing volume, the net area of opening is to be taken, the volume to be considered as the product of the average velocity and the net area of the opening.
7. If the anemometer is held 2 in. from the register face, no deduction shall be made for the area occupied by the register mesh.

The
Heating and Ventilating
Magazine

VOL. XIV. NO 8.

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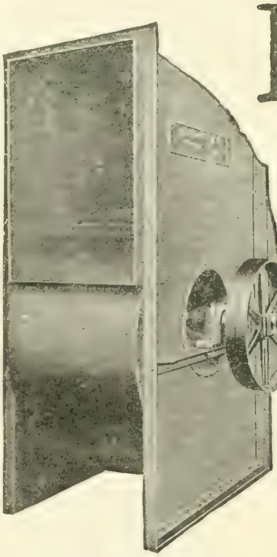

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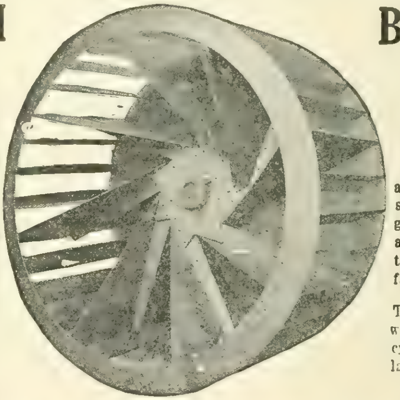

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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. AUGUST, 1917 1123 Broadway, New York

Correct Method of Piping Dry Returns

How "Back-Firing," and Other Troubles May Be Overcome in Gravity Steam Heating Work.

In many gravity steam heating systems the construction of the building or other considerations require the placing of a return line above the general water-line of the system, this constituting what is commonly termed a "dry return" to distinguish it from the returns located below the general water line of the system and filled with water on this account. Every heating man knows that on a two-pipe gravity job a wet return is always preferable to a dry return and almost every one will use a wet return if conditions permit. Where insurmountable obstacles to a wet return are encountered and a dry return is, of necesity, used, certain features will make this dry return (or its equivalent) operate satisfactorily whereas the omission of such features is liable to lead to troubles more or less unexplainable.

Some old and seasoned heating men will smile and think that they will never have trouble of this kind but do not be too sure! One of the best heating contractors of the metropolis put in heating systems for twenty years and has a more or less country wide reputation—but the dry return got him! And after twenty years experience too!

What *are* the troubles likely to be experienced with a dry return and what are the causes of the troubles? Since the dry return is not filled with water at any time, it must at all times be filled with either steam or air, depending on whether the system is in operation or not. At certain times when the system is starting up or closing down it may be filled with a mixture of both steam and air.

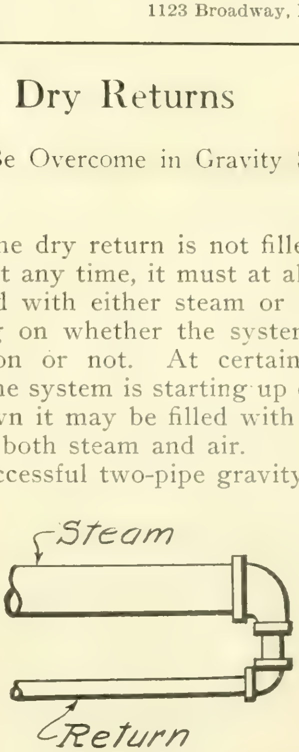


FIG. 1—COMMON DRIP ON STEAM MAIN.

A successful two-pipe gravity steam system should supply steam to the radiators through the steam main and its risers and branches and should return the water of condensation to the boiler through the return main, its risers and branches. As soon as a system is piped so that steam can be supplied through both supply and return mains at the same time trouble begins to brew. A wet-return system makes it impossible for steam to enter the return main and to be fed to the radiators through the return end; thus many troubles are avoided. On the risers, however, conditions remain the same and a discussion of the riser problem is taken up later in this article.

The most exasperating thing about the matter of the dry return is that some jobs will work to a satisfactory extent without any safeguards at all and others will give any amount of trouble and necessitate considerable expense to rectify.

DISPLACEMENT OF AIR FIRST REQUISITE OF DRY-RETURN SYSTEM.

The first requisite of a dry-return system is the design of the supply and return mains so that on starting up the system the steam will displace the air in the pipes in a quiet and continuous manner until all the air is expelled from the system and its place taken entirely by steam and condensation. The second requisite is that during this process the steam should be kept from entering the return conection of the radiators because if this happens it will reach the air valve on the return end, and close it, long before the air has been expelled from the radiator. The result of such a process is a radiator hot at both ends and air bound in the middle sections.

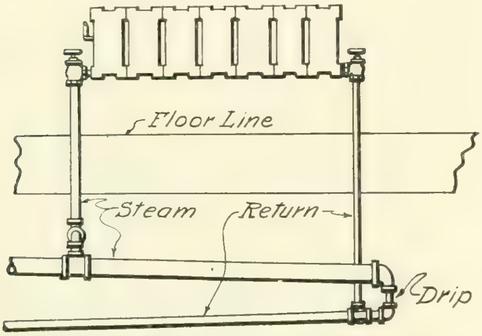


FIG. 2—EXAMPLE OF RADIATOR THAT WILL BACK-FIRE.

A TYPICAL ILLUSTRATION OF "BACK-FIRING" FROM THE RETURN END.

If the paths whereby the steam enters the dry return pipe are considered, a better idea is had of how the suggestions and ideas later illustrated will remedy the trouble. Suppose a two-pipe, gravity, dry-return system to be starting up—the steam flows out along the stem main and compresses the air in the piping and radiators, driving it gradually out of the system through the automatic air valves. Probably at the end of the steam main and at various intermediate points the main is dripped into the return line, the drip on the end of the main being arranged somewhat as shown in Fig. 1. With such dripping the steam passes down into the return main and will work up into the nearest return connections, especially if radiators are connected as shown in Fig. 2, causing adjacent radiators to feed from the return end, or to "backfire," as it is sometimes termed.

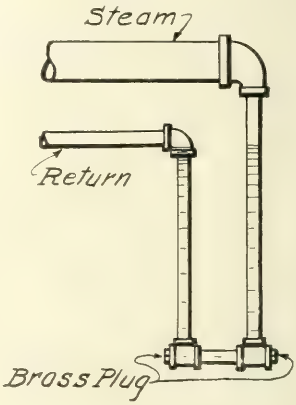


FIG. 3—WATER-SEALED DRIP ON STEAM MAIN.

That the steam does this is a positive fact and the back-firing is caused entirely by the steam travelling around such a drip connection in less time than it takes to blow the air out of the adjecent radiators. *If* the radiators relieved of air *rapidly* enough or *if* the steam passed around the drip connection and back-fired *slowly* enough—so that the air were all expelled from the radiator before the back-firing steam closed the air valve—all would be well, as the admission of steam to a radiator through the return end, after all the air has been expelled, is not a serious matter.

Trouble from this source, however, is indeed so common as to be guarded against by almost all experienced heating men by water-sealing the drip as shown in Fig. 3. If the seal is made about 3 ft. deep it will effectually prevent such trouble.

Similar to this trouble, and closely related to it in cause, is the connection of a small radiator located on the same ceiling with the mains, somewhat as illustrated in Fig. 4. Steam flowing out the steam main will enter this small radiator of, say, 5 to 10 sq. ft., and blow the air out of it in one-tenth to one-fifth the time it takes to blow out a 50 sq. ft. radiator located above on the return riser shown. As a result during the remaining nine-tenths to four-fifths of the time it passes through the small radiator, out into the return main, up the return riser, and back-fires the 50 sq. ft. radiator.

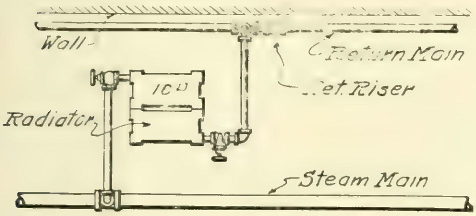


FIG. 4—SHORT-CIRCUITING THROUGH SMALL RADIATOR.

REMEDY FOR "BACK-FIRING."

Now as to the remedy. The same scheme applied to the drip connection will also give satisfaction, if used on the return from the radiator. This is illustrated in elevation, Fig. 5, where both the radiator returns and the return riser are shown water-sealed. The water seal does not need to be quite as deep in this case because the difference between the pressure in the radiator return and the pressure in the main return will be less than the difference between the pressure in the steam main and the pressure in the return main. The less difference is caused, of course, by the fall in pressure of the steam while passing through the radiator.

Another remedy is to water-seal the whole return by the establishing of a false water-line, as shown in Fig. 6. This can be done if there is sufficient room between the level of the steam main and the level of the return main. Usually about 24 in. difference is the minimum which will give satisfaction, the false water-line being made about midway between the two levels, thus giving 12 in. of water seal and 12 in. from the false water-line to the steam main for good drainage.

The rise in the return pipe made to establish such a false water line must be connected to a small line from the steam main, this line being called a "balance" pipe and shown in Fig. 5. Its real purpose is to admit steam to the top of the riser so as to break the syphonic action. Without such a balance pipe the return main will fill up with water until the level of the false water-line is reached and the water will then overflow down into the lower level. Owing to the longer leg on the low side of the rise a perfect syphon is created which will not only pull all the water out of the high portion of the return main, but will also unseal all connections to it and at the same time cause the water to return to the boiler in intermittent slugs, thus fluctuating the water-line. The amount

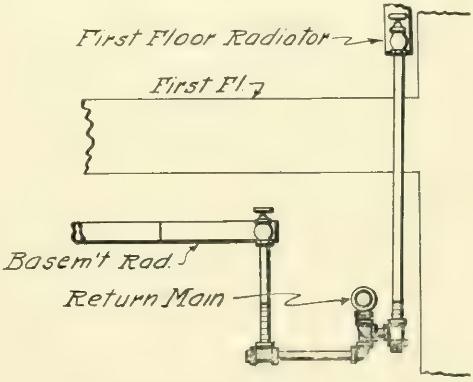


FIG. 5—WATER-SEALING TO PREVENT BACK-FIRING.

of such fluctuation will depend on the relative capacity of the water contained by the false water-line which is syphoned out and the area of water surface in the boiler.

DIFFICULTIES WITH DRY RETURNS ON BASEMENT FLOORS.

Difficulty may be sometimes experienced where dry return mains are run along the basement floor. If it is attempted to water-seal the steam pipe drips connected to such a return the water-seal must be placed above the floor, resulting in a perfect syphon. If a balance pipe is introduced at the top of such a syphon then the water seal is bypassed and rendered useless. In a case of this kind a knowledge of plumbing is most beneficial for in plumbing (in cases where syphonage is liable) non-syphon traps are frequently used when venting or breaking the syphonic action by other means is impossible. These traps simply retain enough water to resist syphonage or to re-seal themselves immediately should they be syphoned; as the amount of water retained in a steam main drip seal is small, its syphoning out will do no harm, while all the good can be obtained if the loop is immediately re-sealed. Under such conditions an arrangement something like that shown in Fig. 7 will accomplish all that is required, the large piece of pipe being two to three times the diameter of the drip pipe and retaining enough water to allow syphonage to take place and still re-seal the connection at once.

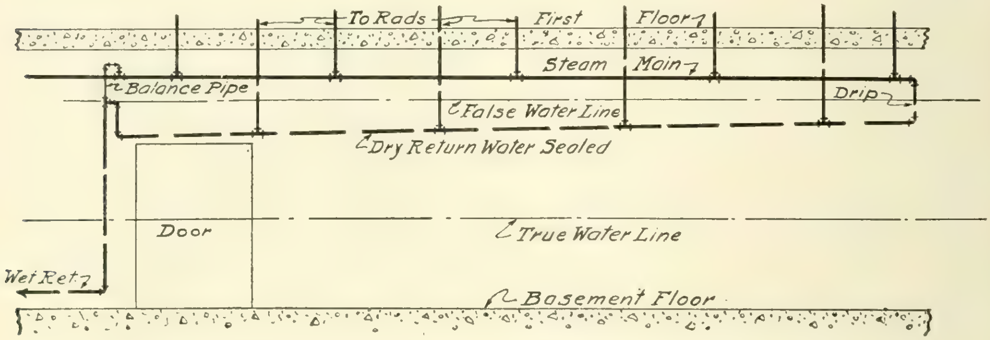


FIG. 6—RETURN WATER-SEALED BY ESTABLISHING FALSE WATER LINE.

The danger of backfiring through a radiator is not as generally recognized by heating men as the danger of doing the same thing through a steam main drip connection and the argument is often advanced—when trouble is encountered from this cause—that the radiator connection cannot be the trouble because, if this were so, the radiators connected to the steam and return risers should do the same thing. The truth of the matter is that they *do*—if the conditions are right!

Take, for instance, radiators connected as shown in Fig. 8; about 99 times out of 100 such radiators will work all right, but if one radiator is very *small* and the next very *large,* and especially if the steam riser supplying the small radiator gets the steam *first* or is a more *heavily loaded* riser then trouble is almost sure to occur. One job demonstrated this peculiarity

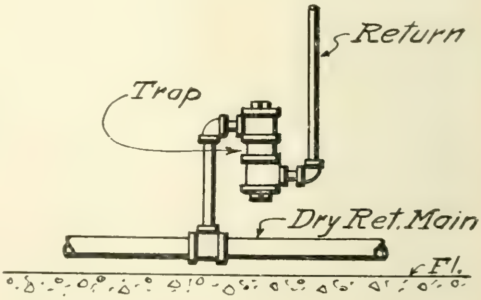


FIG. 7—NON-SIPHON WATER-SEAL.

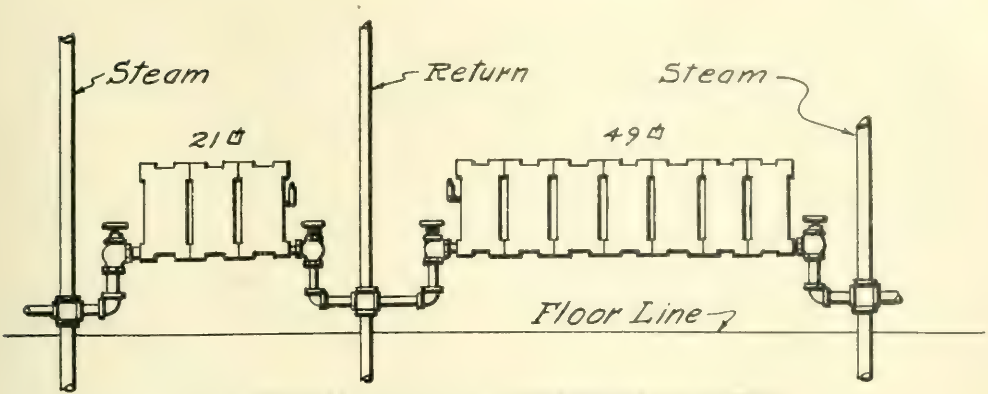


FIG. 8—TYPICAL RADIATOR CONNECTIONS TO RISERS.

most emphatically, the janitor having to remove the air valves on the larger radiators every morning and let them blow for some time before he succeeded in relieving the air.

Where the radiators are approximately the same size the action in each is more or less simultaneous but in cases of great discrepancies between the sizes some safeguards should be used. Several old authorities on heating recommend the use of various schemes, but they advocate their use on *all* radiators. Experience has shown that this produces an unnecessarily expensive job and it is entirely sufficient to use the safeguards suggested below only in cases where one radiator exceeds, by 50% or over, the next adjacent radiator (on the return end). Probably in all cases where the difference is less than this the steam from the smaller radiator will not get to the air valve on the larger radiator in time to cause air binding to a serious extent.

THREE METHODS OF TREATING RADIATOR RETURNS.

The three most satisfactory methods of treating the radiator returns under such conditions are illustrated in Fig. 9. In "A" a check is inserted in the return from the *larger* radiator only. A check in the return from the smaller radiator is, of course, not needed as there is no danger of steam coming across from the larger amount of surface. Care must be taken to provide for a vertical head of water above the check so as to insure the lifting of the flap without holding back the water in the radiator. As a general thing, where radiators are set near the floor this means that the check valve must be placed on the ceiling below—which may be objectionable for various reasons. "Impulse" check valves are recommended for such use.

In Fig. 9, the scheme shown in "B" leaves the ceiling below perfectly clear, but establishes a pocket for the

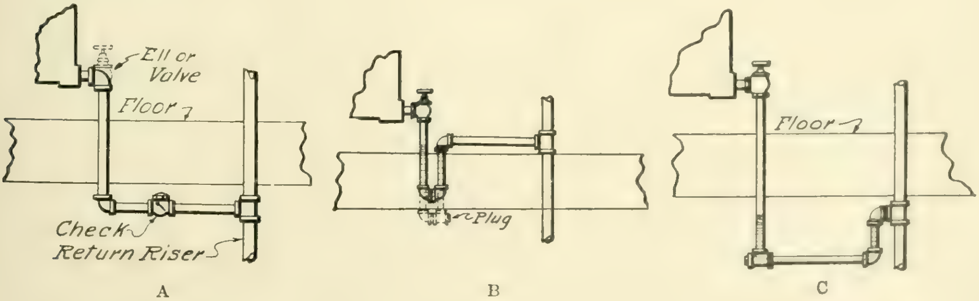


FIG. 9—THREE METHODS OF SAFEGUARDING RADIATORS FROM BACK-FIRING.

collection of rust which it would be difficult to remove. A better design would be to carry it through to the ceiling below and provide it with a brass plug as shown in dotted lines. Such a water seal could be used on the return ends of *both* the larger and smaller radiators, the seal on the small operating to prevent the flow of steam into the return riser and the seal on the larger radiator operating to prevent the entrance of steam through the return even if the steam had obtained access to the return riser itself.

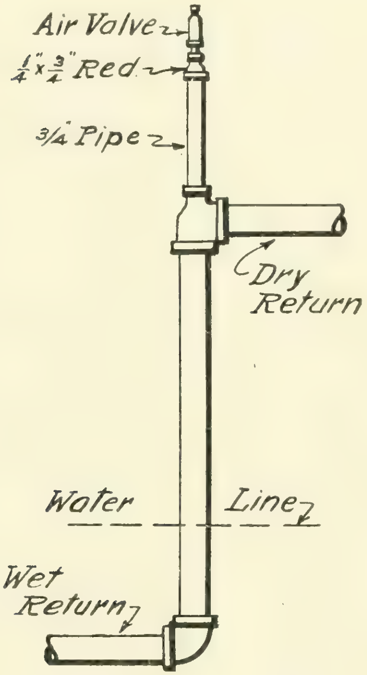


FIG. 10—AIR VENTING ON RETURN MAIN.

The seal shown in "C" is only a modification of the idea illustrated in "B" so as to make the runout come on the ceiling below, instead of above, the floor; otherwise the two schemes are quite similar but where compared with "A" it is readily seen that the runout in "C," in order to get a good water-seal, must come quite a little lower than the runout would come in "A."

One more point; it is important to remember that whenever a dry-return main drops under the water-line or becomes water sealed a pocket if formed which results in the collection of air at this point. The air is prevented from going forward by the water in the wet-return and is prevented from going back by the water and steam behind it endeavoring to pass it in the return main. Such a condition produces unusual and more or less mysterious troubles—the radiators on even the *second* floor may fill with water, the air valves spurt water, cracking in the pipes, fluctuation of the water line, loss of water from the boiler—later coming back with a rush and going up out of sight in the gauge glass—all this because the return is blocked with air.

If a tee is substituted for the elbow where the dry return starts to drop and a piece of ¾-in. pipe is used to extend up to good-sized air valve, placed 12 in. to 18 in. above the level of the dry return, all will be well. The air will be relieved and the condensation will flow back in a constant stream without hindrance. The exact method of doing this is illustrated in Fig. 10.

Of course, a radiator connection near the point of drop has undoubtedly saved many heating systems from trouble of this sort but where the nearest connection to the return main is, say, 15 ft. or more back of the drop, the air cannot get back to this point and find its way out through the radiator air valve.

Requirements For Radiator Humidifiers

With Description of a New Type Capable of Evaporating 2.9 Gallons Per Square Foot of Hot Water Radiator per Day.

By E. P. LYON,
University of Minnesota, Minneapolis, Minn.

In considering the efficiency of air moisteners, such as those that have come on the market during the past few years for use on radiators or in the tops of warm air furnace casings or in warm air registers, it is in order to consider what are the requirements for air moisteners in general.

We may first compare them with the human lung, for occupied houses have these natural humidifiers at work all the time. In our physiological laboratory, in cold weather, the average total evaporation (lungs and skin) of 67 students was almost exactly 2 oz. per person per hour. This would give 48 oz. or 3 lbs. or 1,360 grams per 24 hrs. The average person, therefore, contributes as much water vapor to the air as may be expected by any of the ordinary radiator humidifiers on the market, per foot of radiator.

To maintain a relative humidity of 40% (a low standard) in the writer's house, from 15 to 18 gal. of water per day must be evaporated. Calculations based on the common standard of humidity (60% to 70%), and more or less arbitrary assumptions as to the rate of leakage and renewal of air, give 15 to 30 gal. as the proper daily evaporation for maintaining humidity in an ordinary house. Bryce, of Ottawa, on the assumption of an hourly renewal of air, says 75 gal. of water per day should be evaporated.

Experiments made by the writer show that the air of his house is renewed eight or more times a day, even in quiet weather and with the fireplace flues closed. Of course, wind increases the rate of renewal. There is no outside flue in this house. The writer is convinced that, in ordinary dwellings, with a reasonable number of occupants, an outside flue for removing the air leads to waste of fuel. Moreover, it makes it more difficult to maintain humidity.

LOWER HUMIDITIES ADVOCATED.

This brings us to the question, what is reasonable humidity? In the writer's opinion, the usual standard (60% to 70%) is entirely too high for a northern home. It cannot be maintained without special mechanical devices. Although the writer's house is of good construction and has double windows, nevertheless, in sub-zero weather, a relative humidity of 50% inside the house causes disagreeable condensation on windows and on exposed outside walls, with consequent damage to wall paper, etc. There are no experimental data, so far as the writer knows, regarding optimum humidity. The injurious effects of simultaneous high temperature and high humidity are well known. But beyond the ordinary observation of chapped hands, dry skin, chilly feeling and the supposed greater prevalence of colds and respiratory disorders, we have no data as to the effects of low humidity. The furniture, rather than the human occupant, is likely to protest against an excessively low humidity in the indoor air.

In the absence of experimental data as to the optimum humidity for dwellings, let us assume that 40% to 45% is a fair standard for our northern climate. Can such a standard be maintained without special mechanical devices, involving fans, moistening chambers, etc? The writer's experience applies only to hot water heating. Based on the principle of indirect radiation (a radiator set in the basement with air flues down and up) the writer has built a fairly adequate humidifier in his house. The air moved by this radiator passes through a chamber in which sheets to the extent of 100 sq. ft. are kept constantly wet. This surface for evaporation ought to be doubled or trebled. Otherwise the scheme works well and is automatic. Particulars concerning this apparatus will be given to anyone interested. In this article, however, it is desired to discuss only such humidifiers as can be placed on room radiators and may, therefore, be used by tenants and others who are not able to make structural changes in their dwellings.

Manufacturers of radiator humidifiers, as a rule, do not seem to realize that extent of water surfaces and the maintenance of air currents over these surfaces are more important factors in evaporation than is the temperature, under the conditions with which we have to deal. Moreover, with any wick system, it is important that distilled water be used in order to avoid the early clogging of the wick by the solids left on evaporation.

In the design of the types of radiator humidifiers here described and illustrated, the writer has attempted to avoid these errors.

Type 1 consists of a number of trays of galvanized-iron placed one above the other, being supported by vertical ends of the same material. The trays are so arranged that the current of air rising from the back of the radiator is forced over the water in the trays. This apparatus is 12 in. wide (from the wall) and 13 in. high. It should be as long as the radiator will accommodate. The trays are 18-in. higher at the back than at the front to prevent water from running over the back to the floor. The ends project in front ⅛-in. beyond the trays (except the bottom one) and the front of all the trays except the bottom one slant back and down so that the excess in filling will run into the bottom tray. This design gives 10 sq. ft. of evaporating surface for each foot of radiator occupied.

Experiments show that about ½-in. between trays gives good results and at the same time avoids excessive height of the apparatus. A model of this type, 30 in. long, with twelve trays, has evaporated 3.6 gal. a day on a hot-water radiator or about 1.4 gal. per foot of radiator. This is four or five times as effective a showing as that made by any radiator humidifier on the market, according to the writer's experience.

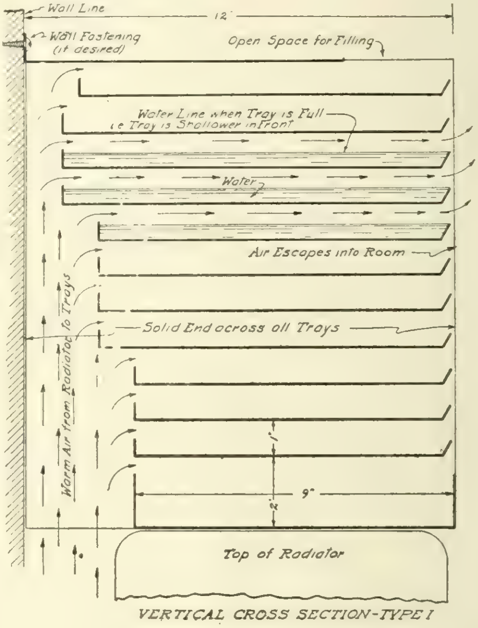
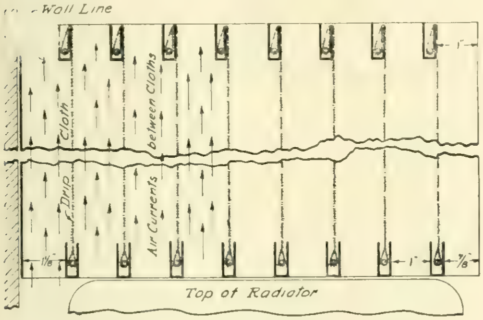

Wall Line
12"
Wall Fastening (if desired)
Open Space for Filling
Water Line when Tray is Full i.e Tray is Shallower in Front
Water
Air Escapes into Room
Solid End across all Trays
Warm Air from Radiator to Trays
1"
9"
2"
Top of Radiator
VERTICAL CROSS SECTION-TYPE I

FIG. 1—RADIATOR HUMIDIFIER MADE UP OF WATER TRAYS.

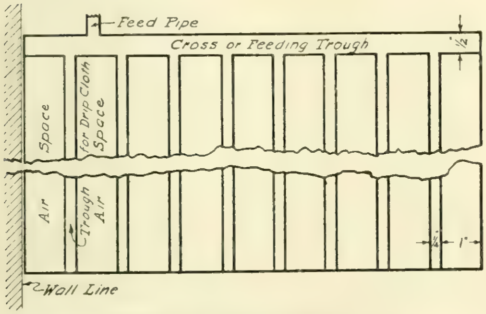
This type is filled by hand and the top tray is made narrower to diminish the liability of spilling water on the floor. If the radiator in use will not support the apparatus (round topped coils) the humidifier can easily be made to hang from the wall.

In Type 2, two series of troughs running lengthwise to the radiator are arranged so that each upper trough is vertically above a corresponding lower trough. The illustration shows a design of Type 2 with eight drip cloths. This device is 11 in. wide (from the wall) and may be any length and height. The top troughs are ¼-in. wide and ¾-in. deep in front (where drip cloths come over) and ⅞-in. deep behind.

The center of each lower trough is vertically beneath the front edge of the corresponding upper trough. Otherwise the lower trough system is like the upper system shown in the diagram, the run-off pipe from the lower cross trough corresponding to the feed pipe in the upper system. The evaporating surface will vary with the height and number of drip cloths used. But as both surfaces of the cloth are exposed to the air, the surface of evaporation per foot of radiator might easily be made 60-80 sq. ft.



VERTICAL CROSS SECTION - TYPE II



PLAN OF TOP - TYPE II

FIG. 2—RADIATOR HUMIDIFIER MADE WITH DRIP CLOTHS

The cloth sheet from each upper trough is suspended and kept wet by capillarity, the excess of water running off into the corresponding lower trough. The heated air rises between these suspended drip cloths and passes into the room.

Each series of troughs is connected to a corresponding trough running crosswise to the radiator. The upper cross trough may be fed with water from an inverted bottle so arranged as to maintain a constant level in the upper troughs. The excess running off from the lower troughs may be received through a rubber tube into a bottle or pail on the floor. But the frequent attention required by such a system constitutes a serious drawback. It is much better to supply a constant small stream of water from the city system and carry off the waste to the sewer. On the first floor of houses this can usually be done by boring two small holes through the floor back of and at one end of a radiator. Through these holes a small pipe may be brought up for the supply and another led down to a sink or other sewer opening for the waste. The expense is slight, the system becomes automatic, and the structural change is negligible.

As capillarity is depended on only to carry the water over the edge of the upper troughs, the cloth does not become clogged by evaporation. Each cloth is hemmed top and bottom, and a rod of galvanized iron in each hem holds the cloth flat. Old sheets were used in the model. Cheese cloth did not work well.

The vertical width of the drip cloths is important. If the sheets are very wide, the cooling effect of evaporation interferes with the air currents and lowers the efficiency; e.g., sheets 21 in. wide were not so efficient as those 14 in. wide. The optimum width for given conditions could be ascertained only by trial.

A model of this type 28 in. long and with eight evaporating surfaces 14 in. wide gave a rate of evaporation per 24 hours of 6.7 gal. (average of two tests), on a steam radiator at the University of Minnesota Medical School, and exactly the same amount (average of two tests. Jan. 14 and 15, 1917; sub-zero weather), on a hot-water radiator at the writer's house. This is 2.9 gal. per foot of radiator per day, or about ten times the efficiency of any radiator humidifier found on the market.

The apparatus looks like a galvanized-iron rectangular box on top of the radiator (or hung from the wall in case the radiator coils are not flat on top). It may be painted or gilded to correspond with the radiator, or papered to correspond with the wall. Doubtless the severity of outline could be eliminated by an esthetic designer. Probably cheaper material, e.g., heavy paper, might be used for the outside covering, only the troughs being of metal.

Drying Money

By H. C. RUSSELL.

(Read at the summer meeting of The American Society of Heating and Ventilating Engineers, in Chicago, July 18-20, 1917.)

This paper is a brief description of the apparatus and methods used in the drying of paper currency at the Bureau of Engraving and Printing at Washington, D. C. As is perhaps well known, all postage stamps, United States bonds, internal revenue stamps of sundry kinds and all paper currency are printed at this Bureau which is a part of the Treasury Department. It is with the drying of the paper on which the currency is printed that this paper deals.

The printing of paper currency is, of course, the most exacting kind of printing known, and all materials must be of the very finest quality and all workmanship must be the most skillful in order that an article may be produced that will practically defy counterfeiting. To obtain the best results in fine printing the paper must be damp. It consequently follows that for the subsequent operation of finishing, the sheets must be dried, and drying must be done as rapidly as possible consistent with the quality of paper used.

The work at the Bureau is printed on comparatively small sheets, viz: 8¼ × 13½ in. for currency and 18½ × 20¾ in. for stamps. Experience had developed a system which was perhaps unique, but it gave good results. The method was to dry the paper in so-called trays, which were constructed of galvanized iron frames 1 in. deep with woven wire mesh bottoms, in which the sheets were laid horizontally, practically filling the trays in depth, 60 sheets for stamps and 60 to 80 sheets per tray for currency. When full, the trays were placed in open racks or frames, the cleats on which they rested being spaced so as to leave approximately 1 in. between the trays for the circulation of air.

The racks were placed in one large room in rows with aisles between and were open on the two sides facing the aisles. Perforated galvanized iron air pipes were run through the racks vertically with the perforations so spaced and directed that the air could pass over and under the trays. The vertical pipes were connected to a system of distributing mains communicating with an air heating chamber which was a hot blast heater provided with coils and a centrifugal fan from which the hot air was sent to all racks in the room. After performing its function of drying, the air was permitted to escape out the windows.

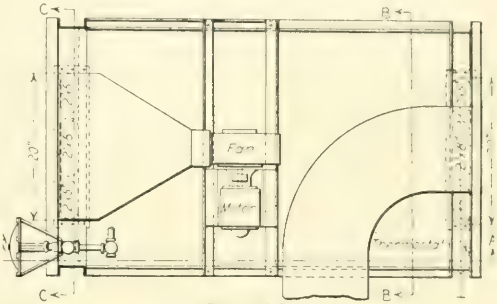
The dry room was open all day for the reception of work and when the presses were stopped, the room was closed and the heat turned on. The heat remained on until the attendant judged the work to be dry, which was often quite late if the outside humidity was high. This made a very hot room for the day force to enter and remove the work next morning, quite often as much as 160 deg. On account of the various kinds of work using different weights of paper and different sizes of sheets, it was extremely difficult to so regulate temperatures and duration of heat to suit the different conditions.

The growth of the output of the Bureau was largely the reason for the crowding of the drying room, as space was not available for separate rooms for drying with individual air heating apparatus. The press rooms were in different parts of the building, but all work had to be taken to one drying room.

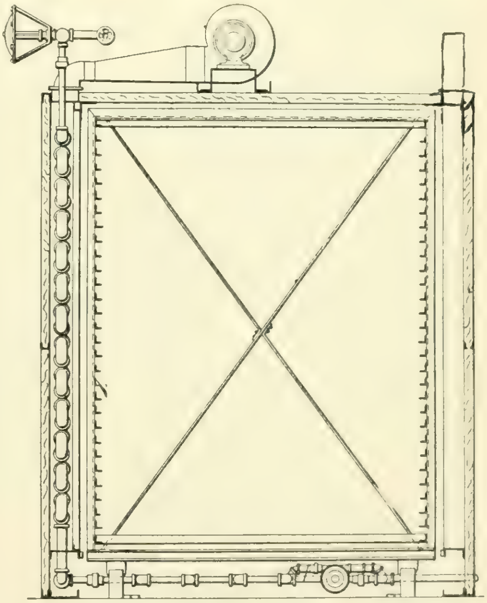
When the new building for the Bureau was designed, it was decided to have a drying room contiguous to each press room, which called for a total of seven drying rooms. It was also decided to still further divide the work of drying by the use of separate closed boxes or cabinets, each to be well insulated to reduce the heating up of the dry rooms in the summer to a minimum. Each of these cabinets was fitted up with individual steam coils and fans heating and forcing the air through the boxes, and as they were to be closed, a system of exhaust ducts were necessary to allow the escape of the moist air. The fans are motor driven and placed each on its own box and took its air supply from the main room, fresh air coming into the main rooms to take its place through grated transoms.

Experiments, conducted for several weeks to determine the size of the individual boxes, the amount of air necessary and its distribution, and the amount of heating surface necessary, resulted in the construction of 264 boxes like the one illustrated in Figs. 1 and 2. They are essentially closets constructed of galvanized iron, insulated with 1½ in. of hair felt, the joints riveted and bolted and made tight with wool felt. They are without bottoms and are bolted to the composition floors of the building, the joint being made tight with wool felt. The doors are double, two fold, and when closed make a tight joint with the box, each other and with the floor.

The object of the insulation and the air tight construction is to prevent the loss of heat from the boxes into the drying room so that the operations of spreading work in some boxes and drying in others may proceed simultaneously without discomfort to the attendants, who are compelled to stay in the drying room while work is being spread. Some heat is necessarily radiated into the rooms, but only a small amount of the moisture laden air escapes into the rooms; a portion of the radiated heat, however, is returned to the boxes



Plan of Top

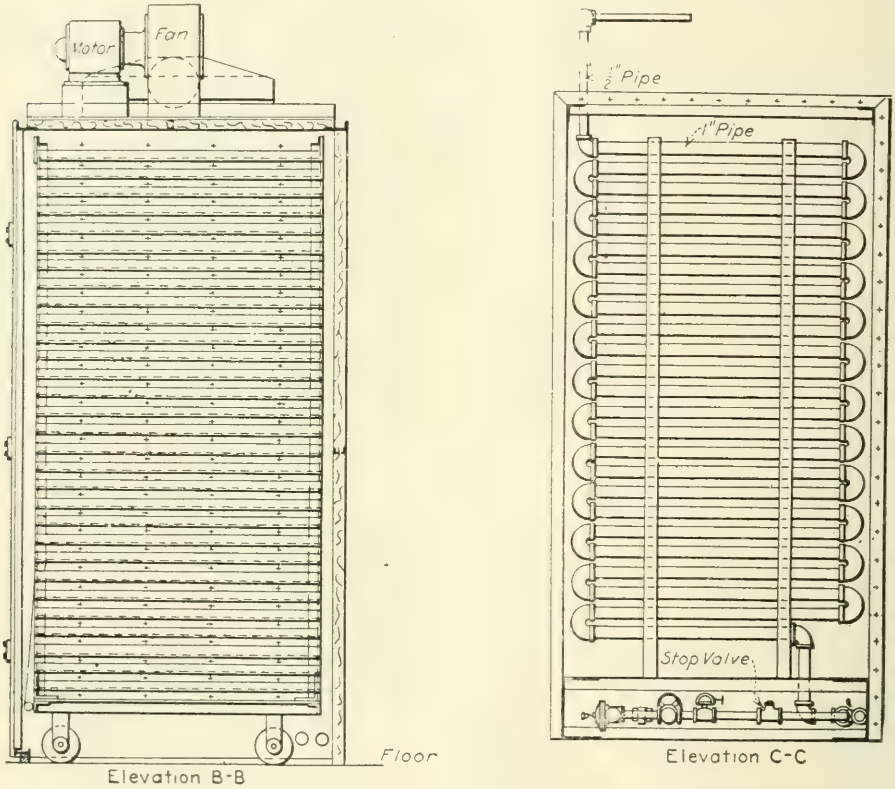


Elevation A-A

FIG. 1—INDIVIDUAL DRYING BOX, WITH FAN AND DUCTS.

through the air supply drawn from the room.

It will be seen from Figs. 1 and 2, that the fans deliver the air into the top of the box, whence it is forced downward over the coil surface and is delivered from the heating chamber into an equalizing air space, thence through a perforated diaphragm into the drying chamber, the perforations being so arranged that the air passes over and under the work in the trays arranged as in the original dry room which has been previously described. The condensation from the steam coil passes through another coil laid on the floor and is delivered through a thermostatic trap to a common condensation return main. The trap is by-passed with a connection containing a ⅜ in. needle valve.



Elevation B-B

Elevation C-C

FIG.2—SECTIONS OF THE DRYING BOX, SHOWING HEATING COILS AND TRAYS.

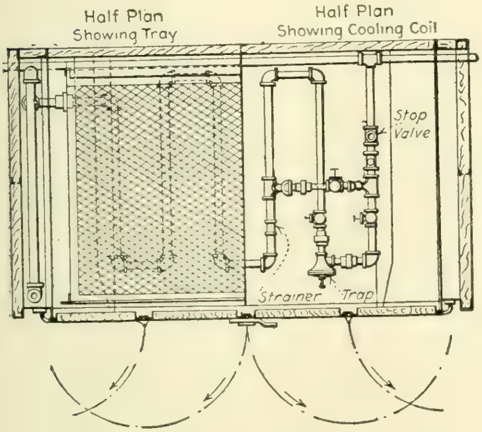
The trays are supported on a car or truck so that if for any reason a given box cannot be heated or fails to act, the work therein may be readily transferred to another spare box.

One of the principal advantages of the new system is that any desired temperature may be maintained in any individual box, and when the work in that box is dry the heat can be cut off without affecting other boxes. After the heat is cut off, the fans can be kept running long enough to reduce the temperature of the box to a comfortable temperature before the attendants need to enter the box. This cooling also has the effect of seasoning the paper, reducing the brittleness which is sometimes the effect of too rapid drying.

One of the greatest difficulties attached to most kinds of drying, the danger of damaging the product by too rapid drying or by circulating air of too high a temperature or too low a humidity, is present in only a mild degree in drying this kind of paper.

The air supply to each box is approximately 120 cu. ft. per min. According to the temperature and humidity of the air supplied to the coils, the condensation amounts to from 10 to 12 lbs. per hour for each box. The dry rooms, which adjoin the main press rooms, were designed to hold a total of 336 boxes, of which 264 were installed, leaving a slight margin for growth.

The dry rooms were designed by George E. Reid of the Office of the Supervising Architect, which office had charge of the design and construction of the entire building. The writer is indebted to Mr. Reid for practically all the data on which this paper is based, and in fact a large part of the paper is his own verbiage.



PLAN OF DRYING BOX.

Mr. Reid designed these dry boxes after considerable experiment in which he built a dry box and carried out his work under conditions of actual practice. This experimental work was done at considerable expense but as an answer, the dry boxes have given perfect satisfaction. They were installed by the W. G. Cornell Co., of New York, as contractors, at a cost of about $125,000.00. The boxes were built by the Buffalo Forge Co., Buffalo, N. Y., and the fans are of the Sirocco type furnished by the American Blower Co., Detroit, Mich. The thermostatic traps are of C. A. Dunham Co., manufacture.

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Air Moistening Device for Warm Air Furnaces.

A novel scheme for securing the proper degree of moisture in connection with the use of a warm-air furnace has been proposed by a member of the engineering division of the Iowa State College.

A slot 4 in. long and ½ in. wide, with the long dimension horizontal, was cut near the top of the galvanized-iron furnace jacket directly over the evaporation pan. A strip of wire cloth 8 in. wide and 4 ft. long was folded lengthwise through the center. A sheet of asbestos the same size was then folded in the same way. The paper was then placed between the two layers of wire cloth and sewed in place, using a wire drawn from the edge of the cloth.

This combination strip was then slipped in the hot air chamber through the slot in the furnace casing until the lower end of the strip could be drawn into the evaporating pan near the furnace bottom. The upper end of the strip was opened for a funnel.

A connection was then made in the water pipe in the furnace room and pet cock installed in this connection just above the funnel in the upper end of the combination strip. Water allowed to drip into the funnel saturates the upper end of the asbestos strip. The length of the strip depends upon the rate of supplying water and temperature within the hot air chamber. In case water is supplied more rapidly than evaporated the excess collects in the evaporation pan below. As the weather moderates the amount of water supplied the moistening apparatus should be decreased or shut off.

In case water cannot be had in the furnace room a pail filled once a day with water can be supported by a hook placed in a floor beam above the furnace. The pail should have a hole punched in the side near the bottom and a pet cock soldered over the hole. Water can then be allowed to drip slowly through a piece of small hose into the funnel at the upper end of the asbestos strip.

A small hygrometer should be hung near a thermometer in one of the rooms. If a humidity of 30% to 40% is maintained the temperature of the room can be kept at 3° to 5° lower with more comfort than if the humidity is allowed to fall to 5% or less.

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THOSE who have long been regular attendants at the meetings of heating engineers must be impressed by the gradual withdrawal of the old-time figures in the profession, many of whom are numbered among the leading pioneers of the art. These men witnessed practically the inception of the industry and, as a group, were contemporaneous. For years their authority was almost unquestioned and they came to be known and are still known as the "old guard" of the trade. Yet today their withdrawal from the field is nearly complete and the interesting question arises, who are to fill their places?

In spite of the tremendous advances made in the art of heating, due largely to the researches of the "old guard," it is a fact that the younger generation has been identified with the more recent advances which have been fully as important as those basic ones that established the industry. This applies to the development of vapor heating, air conditioning practice and to better means for determining ventilation requirements, as well as for fulfilling them. In these three fields a group of leaders has arisen who are rapidly forging their way to the forefront of their profession. We are undoubtedly on the threshold of still greater things in the practice of the art than we have ever known and it is both gratifying and inspiring to find the way is being paved so brilliantly by these typical American heating engineers.

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ACCORDING to the present plans for the construction of the army cantonments now being built, the sleeping quarters or barracks provide for the housing of the soldiers in groups of 200. The heat supply is to be provided by stoves, with smoke flues leading through the second story. Ventilation is to be furnished by natural means through openings underneath the eaves. The prediction is now made that when cold weather comes the first thing the soldiers will do will be to close the openings admitting the cold air. But whether or not that happens, the grouping of 200 soldiers in one barrack, it is stated, is bound to have serious results on the health of the men, one authority openly predicting an epidemic of disease if this practice is followed. Both England and France, it is stated, have long since discovered the danger of thus grouping the men and today the barracks of this type are used as store-rooms and the men are sleeping outdoors in tents. It will be news to a good many that 200 men cannot be safely housed in a single sleeping quarters, but if it is true the medical profession and, incidentally, the heating profession have no time to lose to impress their views upon the proper authorities. The heating engineers' society has already done so, but it is to be hoped the matter will not stop there.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

War Service the Keynote of the Summer Meeting in Chicago, July 18-20, 1917

Whole-souled loyalty to the government and an eagerness for intelligent war service distinguished the summer meeting of The American Society of Heating and Ventilating Engineers from any previous meeting. The presence of officers from the United States and Canadian armies, a representative from the Department of Agriculture and of one of the leading coal operators' associations, all with messages as to the aid heating engineers can give in winning the war, proved a most inspiring feature and one that brought home to every man present the need and opportunity for doing his "bit," whether he goes to the front or serves "behind the men behind the guns."

The army officers gave the necessary military touch to the meeting, while their addresses furnished the spark, if any was needed, to fire the enthusiasm of those present. The representative of the Department of Agriculture had some practical things to say on the subject of food drying, telling in detail of the achievements in this direction made by the Department. Visible evidence of these achievements were exhibited in the form of samples of dried food products, including potatoes, beets, beans, sweet potatoes, tomatoes, etc. The address on the coal situation covered many points that have been so widely discussed in recent months, and while presented from the standpoint of the coal operators, it gave those present a remarkable insight into the ramifications of the coal industry in the United States. Although the minimum prices on some grades of coal have been fixed in conferences with the government, it was emphasized that these prices do not include the grades ordinarily used in house heating and that prices higher than those formerly quoted must be expected next winter and for some time to come.

Delightful quarters for the meeting and registration rooms were secured on the nineteenth floor of the Hotel La Salle.

Morning Session, July 18.

F. W. Powers, president of the Illinois Chapter, welcomed the society to Chicago, the response being made by Henry G. Issertell, of New York.

President J. Irvine Lyle stated, in his address, that the summer meeting was being held in direct accordance with the government's views, which were that all commercial and technical conventions should continue to meet during the war. He said many heating engineers were already giving their services to the government and spoke particularly of the committee that was engaged in developing apparatus and designs for submarine and battleship heating and ventilation.

Mr. Lyle also spoke of the building of the sixteen huge cantonments that are being constructed for the new army and said that the figures as to materials and labor required were so large as to be hard to grasp.

In connection with the manufacture of ammunition Mr. Lyle told of the difficulties in making time fuses for shrapnel shells, which requires the most careful air conditioning. The shells, he said, must be so made that they will function within a very narrow compass after leaving the gun. He discussed the manufacturing requirements in detail and told of the means taken in typical instances to secure proper air conditions. (One of these installations was described in THE HEATING AND VENTILATING MAGAZINE for January, 1917.)

CHAPTER REPORTS.

Chapter reports were presented from the Illinois, Kansas City, Massachusetts, Michigan, New York, Ohio and Eastern Pennsylvania Chapters. An item of unusual interest was reported by the Kansas City Chapter which stated that it was using its efforts to have a law on heating and ventilation passed by the Kansas legislature. The proposed law provides that plans and specifications for all public school buildings must meet with the approval of a school house committee, consisting of the State architect, the secretary of the State Board of Health, and the State superintendent of schools. The chapter is also endeavoring to secure the appointment of a smoke inspector, through the mayor and council. The smoke problem has recently become an important one, due to the scarcity of gas and oil. Two members of the Chapter served on a committee to draft a boiler code for the city, and the code adopted was that proposed by the chapter.

W. M. Kingsbury, in reporting for the Ohio Chapter, told of the new code that is being drawn up for Cleveland which, if adopted, will cover the subject of heating and ventilation.

COMMITTEE REPORTS.

The matter of the establishment of a research bureau was first considered, a report on the subject being made by George W. Barr, chairman of the research bureau committee. The time has arrived, he said, for such a move. As to ways and means, he suggested that the aid of the Bureau of Standards be asked and that, if possible, a research bureau be established at the Bureau of Standards, to be under the direction of the society. Another step that the society could take is the establishment of a chair at some university which could take up research work. Mr. Barr spoke of the will of the late John Bartlett Pierce, vice-president of the American Radiator Company, which provides for the establishment of the Pierce Foundation for research work in heating and ventilation and said that he had written the executors to suggest that the proposed foundation take the form of the endowment of a chair at some university, as proposed. It was voted to continue the committee until definite information had been received as to the possibility of securing aid from the Pierce Foundation.

Professor Hoffman favored research work under the auspices of the government. In lieu of that he favored the establishment of a university chair.

The question turned, to some extent, on whether manufacturers should be asked to contribute to a research fund. President Lyle said he believed 50 firms or individuals, he did not care which, would be willing to contribute $50 a year for, say, ten years, for research work, Mr. Barr believed that anonymous contributions, as was suggested by J. A. Donnelly, might solve the question. Mr. Collamore thought every member of the society should have a share in the proposed research work, and for that reason he advocated a raising of the dues, although he would not refuse additional contributions.

Prof. S. E. Giesecke said the difficulty in establishing a chair would be that no one man could undertake the many investigations that are needed, but if a research bureau were established it could obtain the co-operation of many of the educational institutions.

For the committee on engineering cooperation John F. Hale, chairman, recommended that the proceedings of the National Association of Engineers be published in the next issue of the Journal so that the members could get a better idea of its objects and purposes, and could then determine how far the so-

DINNER TENDERED THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS BY THE ILLINOIS CHAPTER, AT THE CHICAGO YACHT CLUB, JULY 18, 1917.

ciety should participate in this work.

Professor John R. Allen presented the report of the special committee on "Standard Method for Testing Radiators." Professor Allen stated that he had been making radiator tests with electricity as the heating medium and that he would have a detailed report to present at the next annual meeting, comparing this method with the usual method of heating the radiators from an outside source.

For the committee on "Standard Method of Testing Air Washers," E. A. Stacey told of the results accomplished by the Chicago Commission on Ventilation in making dust counts, commenting especially on the successful use of the Hill dust counter designed by Dr. E. Vernon Hill (described in THE HEATING AND VENTILATING MAGAZINE for June, 1917).

The report on "School House Standards" by F. I. Cooper, chairman, was read by Secretary C. W. Obert. It took up the matters of standard forms and measurements which would permit comparisons as to costs of units, and minimum sizes of classrooms and toilet rooms. Mr. Cooper's report was a lengthy one and covered in detail the steps that have already been taken in this direction by other organizations.

A report governing the issuance of chapter charters was presented by F. R. Still, chairman, containing a uniform type of charter. It met with the approval of the meeting.

COMMITTEE TO CO-OPERATE WITH THE NATIONAL DISTRICT HEATING ASSOCIATION.

President Lyle gave an account of the meeting, May 21, at the society headquarters in New York, at which representatives of the National District Heating Association met with representatives of the heating engineers' society. The points discussed included the appointment of committees to outline what research work should be conducted by each association and to see that both societies are working in co-operation; also the programme committees of each body should confer to see that there is no duplication in the matter of papers, etc. Finally, it was suggested that both organizations arrange to hold their meetings at the same place, the district heating engineers to take up the first three days with the commercial topics of interest to the central station heating engineers, and the last part of the week to be devoted to the engineering side of heating and ventilation, including district heating.

The suggestions made were heartily approved by the meeting. President Lyle appointed a committee to co-operate with the National District Heating Association and it was decided to have the so-called "joint" meeting, if possible, the third week in June, 1918.

Regarding the annual meeting of the society, President Lyle explained that the third week in January would hereafter be a very crowded one at the Engineering Societies Building, owing to the fact that the civil engineers now have their headquarters in that building and meet at that time. It was voted to approve the council's plan to advance the date of the next annual meeting to probably the first week in January.

F. E. McCreary then presented the first paper on the programme, on "Hot Water Heating System of the Crane Company Plant," in Chicago.

Military Session, July 18.

Scheduled as a military session, the first speaker Wednesday afternoon was Captain O. N. Solbert, U. S. A., Corps of Engineers, who spoke on "The Engineer in War." Captain Solbert said that modern warfare has become an engineering proposition. If it were merely a question of soldier power, Germany would have won the war long ago. But supplies count for as much as soldiers and the men at home are doing just as much service in winning the war by helping to keep up the stream of ammunition and supplies, as the men at the front.

The internal combustion engine, said Captain Solbert, is the biggest individual factor that has changed the character of modern warfare. This applies to the operation of aeroplanes, submarines as well as vast numbers of motor cars used in military service.

The big element in the work of the military engineer is the time factor. Speed is everything, no matter at what cost. This is the big difference between the military engineer and the engineer in civil life.

Captain Solbert gave some idea of the vast needs of military operations by stating that one mile of front line trenches usually requires 900 miles of barbed wire, 2,650,000 sand bags, 12,000 staves and pickets, 36,000 square feet of corrugated iron, and 1,250,000 lineal feet of lumber.

The present cost of the war, he said, to all of the belligerents, is no less than $100,000,000 per day.

Captain Solbert gave an interesting account of the formation and work of the military arm of the service, taking a division as a basis, for a division, he said, is the smallest independent organization which is complete, with infantry, cavalry, engineers, signal corps, artillery, and hospital service.

Nine regiments of engineers, said Captain Solbert, were leaving the United States that day (July 18) for service in France.

Every man in the country, he said, who has had an engineering education may have his part in the war. It is not so glorious a part, perhaps, as that of the soldier, but it is every bit as important a part.

As Captain Solbert concluded his address he was given an ovation and on motion of Homer Addams, he was given a rising vote of thanks, with further prolonged applause.

In introducing the next speaker President Lyle stated that he did not remember that either the United States government or any other government had ever until now given recognition to the heating engineers' society. But in sending the next speaker, Lieut.-Col. T. E. Powers, of the Canadian forces, to address the society, the Canadian government had conferred a notable honor on the society.

Lieutenant-Colonel Powell won the Distinguished Service Order at the Battle of the Somme and his account of trench life was extremely vivid. At first he said the trenches were inadequately constructed, with only crude arrangements for drainage. This applied also to shelter dugouts, which had no adequate means for their heating and ventilation.

It was soon discovered that drainage must be given more consideration. It became the practice to construct the dugouts at a depth of 30 to 40 ft., and capable of accommodating from 200 to 2,000 men each.

For heating purposes in the front lines biscuit tins and similar receptacles are used with charcoal as the usual fuel.

One of the principal uses which the British army makes of the air shafts in German dugouts is to drop bombs down them, said the officer. On the whole there is little application of scientific heating and ventilation methods at the front.

Colonel Powell was given an equally enthusiastic reception, and a rising vote of thanks, on motion of F. R. Still.

A telegram of greeting was received from Frank T. Chapman who was unable to be present.

The concluding paper of the military session was one on "The Ventilation of Barracks," by W. J. Mauer. Mr. Mauer's paper first dwelt on the subject of the lack of ventilation at the front, as a result of which 200,000 French soldiers alone have been invalided with tuberculosis.

He then gave a list of specifications which should be followed in the construction of barracks. He said the temperature should be maintained at from 45° to 50° F., except when the temperature is 10° below zero, when the barracks temperature should be 40° above that figure.

He said the proper means of heating such buildings was from a central heating station.

Each of the barracks being built for the new army cantonments is two stories high with accommodations for 200 men. Four stoves will be installed on the first floor of each barrack and the stove pipes led through the second story to give some heating effect on that floor. The construction, it is calculated, will keep the CO_2 content at 12½ parts in 10,000. The Chicago Commission on Ventilation has secured permission to make air tests in some of the barracks during the coming winter.

Mr. Still stated that the barracks he had seen in England recently were made of corrugated iron. No provisions were made for heating them, although the past winter was the worst in 50 years in England.

Mr. Mauer was asked about the government order for 12,000,000 sq. ft. of direct radiation, but it was stated that no information is available as yet on this matter.

Dr. William N. Evans stated that, in his opinion, the grouping of men in such sleeping quarters as were proposed was a dangerous mistake and that if the present type of barracks is constructed and used as planned, we shall be confronted next winter with epidemics among the enlisted men of cerebro-spinal meningitis, typhoid and consumption. He spoke of the experience of England which resulted in turning the men out of the barracks and having them live in tents.

H. M. Hart offered a motion that a committee be appointed to report before the present meeting adjourned, with a view of crystallizing the opinion of the meeting and advising the War Department as to the conclusions reached.

After discussion this motion was passed and the chair appointed H. M. Hart and W. F. Verner as a committee to take up the matter, with Dr. William N. Evans to serve ex-officio.

THE CANTONMENT RESOLUTION.

This committee reported at the final session with a resolution stating that since the grouping of soldiers in buildings, holding as many as 200 each, had been attended with dangerous results in England and France and had been condemned by many experienced medical authorities, the society strongly suggested a change in the plans of the barracks at the new army cantonments, if not too late, with a view of securing more healthful conditions in dormitories and offered to place the services of its members at the disposal of the government in re-designing the barracks.

The resolution was generally supported and upon adoption was ordered to be sent to the War Department by telegraph.

President T. I. Lyle presented a paper which was the joint work of D. D. Kimball, A. K. Ohmes and himself, entitled "Notes on the Testing of Heating and Ventilating Equipment."

Notes on the Testing of Heating and Ventilating Equipment.

This paper was an effort to furnish the basis for a code of standard testing methods. As was pointed out there are at present no codes in existence for certain classes of appliances. The paper was divided into two parts, the first being devoted to testing methods and apparata, and the second to mechanics of heating and ventilation. Under testing methods and apparata numerous points were given for measuring room temperatures, room and outside observations, duct temperatures, water or liquid temperatures; and for using recording thermometers, sling psychrometers, hygrometer and hygrodeik, recording hygrometers, barometers and CO_2 determinations, with general instructions for use of CO_2 instruments; also for making dust and bacteria determinations, volumetric air measurements, conditions of pressures existing in a duct conveying air, air movement determinations, etc. The second part of the paper, "Mechanics of Heating and Ventilation," outlined standard practice for steam, hot water, warm air and gas heating. Under humidifying a new type of direct humidifier was included, and directions given for the use of both the "head" type of humidifier, spraying water directly into the air, and the central type which is in general use. Cooling systems were also discussed, with notes on direct and indirect cooling. For dust and fume removal the rules of the New York State Department of Labor, Industrial Board, are recommended for general application.

Mr. Still highly commended the paper, stating that it was of great importance to secure means of establishing 100% efficiency as we know it. The code as outlined might not be complete but it was an important step towards a standard. On motion of Dr. E. Vernon Hill it was voted to appoint a committee on "standard instruments and methods of making tests." The committee will take the paper submitted by Messrs. Lyle, Kimball and Ohmes as a basis.

As one of the government speakers, Mr. H. C. Gore, of the Department of Agriculture, could not arrive until Thursday, the paper by F. E. Giesecke, on "The Friction of Water in Iron Pipes and Elbows" was presented at this session.

The Function of Water in Iron Pipes and Elbows.

This paper gave the results of tests made at the University of Texas last November to determine the friction of cold water in standard American pipes and fittings. The apparatus consisted essentially of two tanks connected by a pipe line containing the pipes or elbows to be tested, and the necessary devices for measuring the velocity of the water and the friction-head. Several charts were included and a formula developed applying to water at about 68° F. flowing through clean iron pipes ranging in size from ½ in. to 3 in. and at velocities up to 3 ft. per second. This formula is as follows:

$$h = 0.00685 \frac{v^{1.77}}{v^{1.275}}$$

Where h = friction-head in feet and v = velocity in feet per second. A modified formula was also given for galvanized pipes based on similar tests. Experiments made to determine the effect of temperature on the friction, with water at temperatures varying from 70° to 140° F. was used. It was found that the friction decreases as the temperature increases. By comparing the expression for the friction in 1 ft. of pipe with that for the friction in one elbow, the number of feet of pipe equivalent in frirtion to one elbow may be found for any velocity of flow. This was done and the results were shown in chart form.

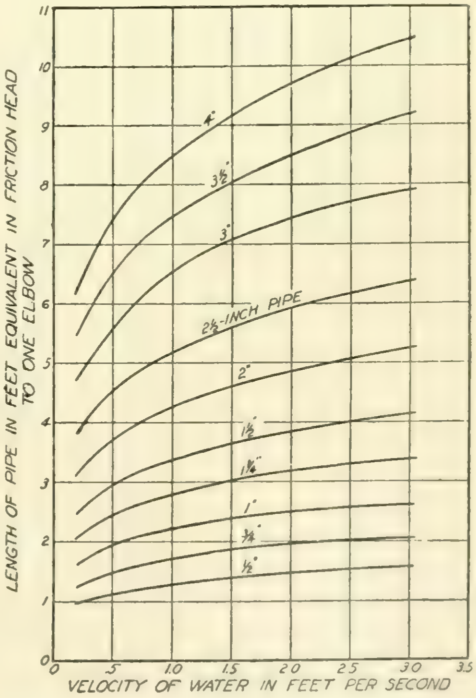


DIAGRAM SHOWING RELATIONS BETWEEN FRICTIONS IN ELBOWS AND STRAIGHT PIPES, FOR DIFFERENT VELOCITIES.

Recent German experiments have been made especially for application to the design of hot water heating systems, but they resulted in two distinct and different formulas, one being $h = 0.0049 \frac{v^{1.84}}{d^{1.26}}$ for pipes with screwed couplings and not larger than about 2 in. diameter and the other $h = 0.0069 \frac{v^{1.80}}{d^{1.37}}$ for pipes with flanged couplings and not smaller than about 2 in. diameter.

These two formulas differ materially from each other and the question arose, is each one applicable to standard American pipe, and if so, which one? These considerations led to the conclusion that we need more data on the friction of water in pipes and that the need justified the cost of a series of experiments.

In the tests as made by Professor Giesecke the friction in an elbow was found to vary much less uniformly with the diameter of the pipe than the friction in 1 ft. of pipe. This, he said, is due, no doubt, largely to the fact that the friction of an elbow depends upon the depth to which the pipe is screwed into the elbow, upon the relative size of the internal diameter of the elbow as compared with that of the pipe and upon the radius of the elbow, and that these values do not vary uniformly with the diameter of the pipe.

In answer to inquiries, Professor Giesecke stated that the formula most commonly used for determining the friction of water in iron pipes is

$$h = f \frac{l}{d} \frac{v^2}{2g}$$

In this formula f is a factor which must be determined by experiment and which varies with the velocity of the water and with the diameter and character of the pipe. American research to determine values of f has given particular attention to the higher velocities of water and to the larger pipe sizes generally used in ordinary hydraulic work, and, for that reason, the published values of may not be sufficiently accurate for the very low velocities and for the small pipe sizes frequently employed in hot water heating.

Drying Session, July 19

The drying session was opened with an address by H. C. Gore, a chemist in the Department of Agriculture in Washington, who has had a long experience in the drying of fruits, vegetables.

Mr. Gore said there was at present no market in this country for dried vegetables, and garden produce generally. There is such a market in Europe.

The drying methods he described were obtained by ordinary electric fans blowing air over trays filled with cut vegetables and fruits.

Mr. Gore stated that the art of drying is so old that no one need to fear infringing existing patents in taking up this work. It was scarcely possible, he said, that any apparatus developed would involve principles that could be called new.

A question as to whether quick or slow drying affects the flavor of the dried products was answered by the statement that ordinarily there would be no marked difference.

The discussion also brought out the fact that there is no loss of flavor in the drying process.

In Germany, said Mr. Gore, a portion of the garbage is now being dried and fed to cattle, coming back in the form of milk. Potatoes, he said, have to be cooked before being dried.

As to analyzing the chemical combinations which make up flavors, Mr. Gore stated that experiments were now being conducted along this line with grapes. A large part of the sweet potato crop rots before reaching the market and this crop could be easily dried and preserved by the method described.

Large quantities of sweet corn are already dried each year and make an excellent dish.

The ordinary drying process, it was brought out, will operate at 50% efficiency, and from this it may easily be determined what the cost will be, given the cost of coal and the fact that 100 lbs. of steam will evaporate approximately 50 lbs. of water.

As to cutting the product in small pieces before drying, there are two opinions on that. For quick drying and where the electric fan process is used, the shredding is necessary as the whole vegetable is well protected by nature against losing moisture. Some of the western drying concerns, said Mr. Gore, prefer drying larger pieces, making the time element longer.

Mr. Gore said that in New York they were using the school ovens in the public school buildings for drying work, and that an opportunity was at hand for the heating and ventilating engineers to develop this idea throughout the country in school buildings equipped with mechanical heating and ventilating systems. Mr. Fleisher described a simple temporary apparatus that could be used for this purpose, especially as during the summer time school plants are usually idle.

If drying is done in wooden houses with heated air, recirculated, there will be sufficient inleakage of moisture to keep the relative humidity fairly low.

F. R. Still then presented a paper on the subject "Dehydrating Fruits and Vegetables."

(This paper will be published in a later issue.)

Mr. Still stated that in Japan they dry almost all food products. He thought there was a big opportunity in this country for developing the drying of food but that it is necessary to educate the public to the quality of dried foods.

Case hardening in drying work, he said, is due to too high a temperature of the air. This temperature should be immediately lowered, and the air velocity kept up.

In the absence of the authors, the papers by C. R. Shadwell on "The Preservation of Food Products by Drying," and by Walter M. Schwartz on "Drying of Fruits and Vegetables," were read by Secretary Obert.

The Preservation of Food Products by Drying.

This paper was devoted principally to drying methods with gas heaters. A gas-heated portable smoke house for curing hams, bacon, sausages, etc., was shown, as well as an arrangement for blowing air through the heater and thence through a dry room. Very few organic materials, the author stated will undergo decomposition or putrefaction without the aid of some foreign agency. They may lose water, and some oleaginous substances may change by oxidization, but otherwise they are stable unless attacked by living organisms. The fact that few adult bacteria can live beyond 165° F. in the presence of water, although dry heat alone only kills with certainty at about 285° F. is an important point in connection with drying by heating. The author gave some practical hints on the preservation of meats, vegetables and fruits by the process described.

Drying of Fruits and Vegetables.

This paper discussed the Proctor system of drying which consists essentially of moving a large volume of air at a low temperature over and through the products to be dried. Approximate figures were given of the saving in shipping vegetables in a dry state, as compared with the cost of shipping in the whole form. In a typical case 100 bushels of sweet potatoes would dry to about 55 bushels, whereby a saving of $103 would be realized, or about 45% in the shipping cost. Again, 100 bushels of red beets are reduced to 10.8 bushels in bulk. The saving in shipments per 100 bushels is $204.20, or 89%. Two types of these driers were mentioned, the 3-apron automatic type, for handling large quantities of different kinds of vegetables and the tray dryer type for handling relatively small quantities.

President Lyle said the papers presented made it conclusive that fruits and vegetables could be successfully dried, but that more information would be welcome as to just what methods are used with the most success. At the request of the chair, Mr. Edwards, of the B. F. Sturtevant Company, gave a detailed account of the work done in a commercial way on the Pacific coast by the Ever-Fresh Fruit Company of Oregon.

Mr. Edward said he believed many firms were going into the drying game in the near future and he described in detail the experience gained by the Ever-Fresh Fruit Company.

A paper on "Mechanical Curing of Alfalfa" by E. M. Bassler, was read by Secretary Obert.

Mechanical Curing of Alfalfa.

In this paper Mr. Bassler, who is an engineer with the Bayley Mfg. Co., described an apparatus which, he stated, was exceedingly simple and inexpensive, because the entire cost of the drying operation, including the cost of grinding, is less than the cost of baling ordinary fluid-cured alfalfa. The apparatus consists of a long sheet-metal cover about 200 ft. in length, 10 ft. wide and 10 ft. high, fitted with a conveyor, and supplied with air from a fan blast apparatus. This type of dryer, he stated, will be made use of for drying fruits. The most economical size seems to be one which will evaporate 10,000 lbs. of water per hour from the green product. In drying alfalfa in a plant of this kind, the author evaporated 9,800 lbs. of water per hour with a steam consumption of 8,400 lbs. per hour. The total cost of producing a ton of pea green alfalfa, taken direct from the field, carrying 69% of moisture, evaporated down to 11% in the finished product, was 83 cents per ton, based on coal at $4.25 per ton delivered.

An additional illustration was shown of a typical alfalfa drying plant capable of taking care of 1,000 acres.

The paper on "Drying Money" by H. C. Russell was read by C. R. Bradbury.

(This paper is published on another page of this issue.)

Mr. Fleisher presented a resolution asking that the Department of Agriculture make an appropriation for the establishment of demonstrating stations to show the advantages of drying food products, inasmuch as there is at present no market for such products. This resolution was adopted and will be forwarded to the Department of Agriculture.

For the committee on code for testing low pressure heating boilers, Homer Addams reported progress and stated that the committee expected to have a final report in shape for the next annual meeting. He said the committee had considered all of the points brought up at the last annual meeting and urged that the members send in additional written discussions based on the report published in the April Journal.

The committee, it was brought out, has advanced so far with its work that it will be prepared to have a complete boiler code ready for adoption at the annual meeting.

Morning Session, July 20.

Arthur K. Ohmes read a paper at the opening of the Friday morning session on "A Study in Air Measurements and Air Flow."

A Study in Air Measurements and Air Flow.

Details are presented in this paper of experiments made to determine the amount of air passing through certain small channels under very slight pressure differences. These pressure differences conformed to wind velocities of from 5 to 12 miles per hour, with the air temperature at 75° F. and 60% relative humidity. The velocity pressures under these conditions would then vary from 0.012 to 0.068 of water column. The illustration shows the general contour of the channels. As was to be expected the rounded channel required considerably less power to drive a certain amount of air through it. A comparison, however, made to compare the actual test results with the accepted theories, disclosed the fact that the theoretical resistances are greater than accurate testing results indicate them to be. The tests show what fairly complete means are available for engineers in conducting tests.

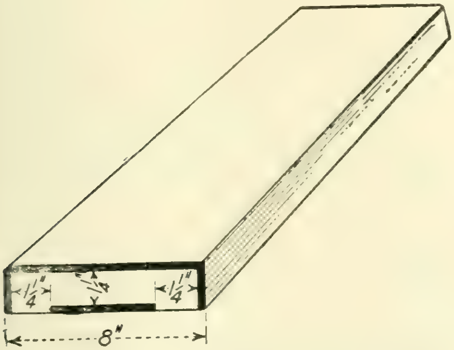
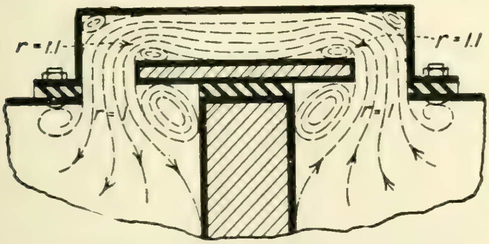
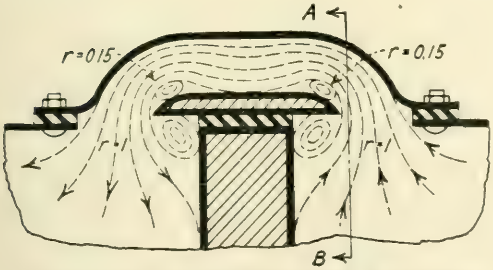


FIG. 1—DETAIL OF THE SQUARE CHANNEL.



SECTIONAL VIEW THROUGH SQUARE CHANNEL.



SECTIONAL VIEW THROUGH ROUNDED CHANNEL.

In discussing the paper Mr. Still stated that as ventilating installations get larger and larger we are finding losses that we cannot account for and we need just such investigations as the one described to give us the needed data.

DISCUSSION OF COAL SITUATION.

At this point the fuel problem facing the country was taken up, the subject being opened with an address on "The Fuel Problem in the United States," by F. C. Honnold, secretary-treasurer of the Illinois Coal Operators' Committee and a member of the Coal Producers' Committee of the Illinois State Defense Committee.

At the present time, he said, the coal problem is mainly one of transportation. If the railroads could furnish the requisite number of cards, he said, the situation would soon relieve itself. The situation would have been even more serious if a ruling had not been made by some of the State Utility Commissions that coal be considered an iron product and given preferential shipment. This ruling, he said, has not been so closely followed of late, as it might have been.

He said the operators have made up about one-third of the coal shortage, but with the heating season only ten weeks off, the situation is sufficiently grave.

Regarding prices to be charged, he

spoke of the agreements entered into by the operators at the recent Washington conference, and said the prices set by the government of $3.50 maximum per ton, would be faithfully observed. Frankly, however, he warned his hearers that householders and others who were looking to a further reduction in prices were doomed to disappointment.

The reduction in coal prices, agreed upon with the government affects only a small proportion of the total amount of coal produced.

One of the elements affecting the price of coal is the matter of idle days at the mine. The average cost to the operators of such idle days is $500 per day.

One of the speakers referred to a possible relaxation of the smoke laws, as had been proposed, but stated that the smoke ordinances were one of the most important measures that could be taken to conserve the fuel supply.

Secretary D. L. Gaskill of the National District Heating Association was the next speaker, his address being devoted to co-operation between the district heating engineers and members of the American society.

He gave details of the work of the Educational Committee of the N. D. H. A. and showed how the heating engineers' society had not kept pace with the National District Heating Association in this work. He made definite proposals for closer co-operation through the work of a joint committee, and heartily endorsed the movement for a "joint" meeting of the two associations.

Dr. E. V. Hill presented a paper on "Ventilation Standards and the Synthetic Air Chart."

Ventilation Standards and the Synthetic Air Chart.

In this paper the author, Dr. E. Vernon Hill, emphasized the point that the problem in ventilation is not so much how to accomplish the desired end, but how to know when that end is accomplished. In other words we must have a standard of ventilation. Dr. Hill then described the development of the synthetic air chart (published in THE HEATING AND VENTILATING MAGAZINE for March, 1917) and how by its use the Chicago Division of Ventilation is able to adjust the relations of temperature, humidity and air motion so as to secure comfortable and healthful conditions. A description was also given of the experimental room at the plant of the Cameron-Schroth Co., which was placed at the disposal of the Chicago Commission on Ventilation.

Before proceeding with the discussion President Lyle abstracted the paper of George T. Palmer on "Are School Rooms Drier than Deserts?" and both were discussed at the same time.

Are Schoolrooms Drier than Deserts?

The point of Mr. Palmer's paper was that air does not necessarily feel dry just because of its low relative humidity. If the feeling of dryness is the result of the removal of water by evaporation, there is no reason, from the standpoint of physics, for expecting a feeling of dryness solely because the relative humidity is low. Mr. Palmer went into the physics of evaporation to prove his point. His conclusions were supported by tests made with the atmometer and Kata-thermometer, the results of which show that the sensation of dryness seems to be associated with the rate of water loss, the quantity, and the adequacy of the replacement process. Schoolrooms admittedly dry, he said, do not appear to be as dangerous to health as deserts. One reason is that schoolroom air does not extract as much moisture from wet objects nor from the human body as desert air.

Mr. Ohmes said that while standards might be established for the winter months, they would not apply to summer weather when people wear lighter clothes and eat less. He expressed the hope that Dr. Hill would make it plain that the standards as proposed in his paper apply specifically to Chicago, as different standards would apply in other sections of the country, the environment being the deciding factor.

Mr. Blackmore called attention to the fact that no standards exist in Nature and that the human anatomy is intended to be subjected to varying conditions.

Mr. Lyle said that the rate of air change will make a great difference in the matter of comfort, so that excessive humidities or temperatures can often be made comfortable by rapid air movement. This is a factor that would have to be taken into consideration in using the "comfort zone" charts.

Mr. Gaskill said that the National District Heating Association was prepared to take the stand that indoor temperatures in this country are too high. The difficulty in thus expressing itself lay in the fact that the public would immediately jump to the conclusion that the district heating companies were working purely from a self-interest standpoint.

Dr. Hill said there was a best air condition in nature and cited the cures of tuberculosis effected in the Alps through the application of radiant heat from the sun, under practically uniform conditions.

F. A. De Boos presented a paper on "Operation of Diaphragm Radiator Valves, Thermostatically Controlled." (This paper was published in the April, 1917, issue of the society's Journal.)

As it was desired to bring the meeting to a close with this session, three of the remaining papers were read by abstract, these being a paper on "Mine Ventilation," by J. J. Walsh; one on "Warm Air Furnace Heating," by I. F. Grumbein; and one on "Use of Refrigeration in Air Conditioning," by L. Nusbaum.

Mine Ventilation.

This paper, written by a mine inspector of the Tenth Anthracite Inspection District was a practical discussion of working conditions with pointers on location of fans, booster fans and design of fan capacity for mine ventilation.

The cantonment resolution was then brought up and adopted, as already stated. While on the subject of military matters, President Lyle stated while many of the members were well able to sacrifice their time and money in government war service, still he thought some provision should be made for meeting the expenses of war committees so that there would be no danger of being deprived of any member's services on the ground of expense.

WAR DEFENSE FUND STARTED.

President Lyle's suggestion was eagerly taken up and it was voted to appoint a war defense fund committee to obtain contributions for the express purpose of meeting the expenses of those members who are or who will be called upon to confer and co-operate with the government bureaus. President Lyle gave it as his belief that no more loyal organization can be found than the heating engineers' society and that enough contributions can be secured averaging from $5.00 to $10.00 per member to meet any expenses that are likely to be incurred.

A resolution of thanks to the Illinois Chapter for its royal hospitality and to the chapter's entertainment committee, of which J. A. Cutler, was chairman, was adopted with enthusiasm and President Lyle took advantage of the opportunity to express his own appreciation, and that of the other officers, for the splendid manner in which the Illinois Chapter had handled the meeting.

It was stated that the paper by J. E. Emswiler on "Measurements of Low Pressure Steam Used for Heating," which were made at the Universtiy of Michigan, would be held over, on account of the lateness of the hour, until the next annual meeting in January.

The meeting then adjourned.

Illinois Chapter Proves Royal Host.

Plans made by the Illinois Chapter for the entertainment of its guests were arranged and carried out on a scale that easily surpassed those of any previous meeting and those who attended last year's summer meeting, in Detroit, will understand that Chicago had to step lively to accomplish this.

The two big events were the dinner and dance at the Chicago Yacht Club and the dinner and garden party at the Bismarck Garden. The former was held on the opening night, Wednesday, and latter on the following evening. These, however, formed only a part of the programme, being interspersed with a luncheon party Wednesday noon for the ladies in the Blue Fountain Room of the Hotel La Salle, followed by an automobile sight-seeing trip through Chicago's extensive and beautiful park system. In the meantime the men met for luncheon in the convention hall on the 19th floor of the hotel.

In the evening special automobiles were provided to take the party to and from the Chicago Yacht Club. The clubhouse, on the water front of Lake Michigan proved a most delightful spot after the comparative heat of the city while the view took in not only a wide expanse of the lake but also showed in the foreground several naval boats, including one of the training ships. Covers were laid for fully 200 members and guests, an unusually large number of ladies being present to grace the party.

The speaker of the evening was Lieut.-Col T. E. Powell of the Canadian Army, who held the close attention of the diners while he told them of the part women were playing in the war, both in France near the front and in England and Canada. Dancing followed in the club's ball room and continued till a late hour.

Thursday morning was taken up with a trip for all, by automobiles to the Corwith plant of Crane Company, where an inspection was made of the extensive hot water heating system installed at this plant. This system, which was the subject of a paper presented by F. E. McCreary at the opening session, is probably the most extensive in existence. Guides met the members of the party on their arrival and conducted them in groups through the plant, many braving the high temperatures of the pipe tunnels extending 1,000 ft. or more to inspect this part of the installation.

The same evening the entire party was taken, again by automobiles, to the Bismarck Garden, the route lying through Lincoln Park, along the lake front. Here an even larger number were gathered than on the preceding evening. Dinner was served outdoors with reflection illuminating the entire garden, presenting a scene of unusual beauty and color. After dinner the party strolled through the garden in groups to the strains of the band music, taking in the dancing in the outdoor pavilion and adjourning later to the Mosaic Room, where an elaborate cabaret performance was staged.

Friday afternoon, after the final adjournment, the golfers at the convention had their party. A special bus was provided to take the players to the Edgewater Golf Club, where some thirty players competed for prizes put up by the entertainment committee. The competition was an 18-hole medal play handicap, each player to fix his own handicap, the winning score to be a figure between 70 and 80, chosen by lot. The figure drawn was 76, giving the first prize, a pair of golf shoes, to A. S. Armagnac, whose score was 91-15, 76.

While a large number of the Illinois Chapter members was on hand throughout the meeting to entertain its guests, the committee in direct charge of the entertainment was composed of J. A. Cutler, chairman; E. J. Claffey, August Kehm and Benj. Nelson, all of whom came in for hearty congratulations on the splendid success of their efforts.

CENTRAL STATION HEATING

Importance of Supervising Piping in Customers' Buildings

By D. E. KARN.

Consumers' Power Company, Grand Rapids, Mich.

In this age of high coal prices, with economy as the main issue, it is well to remember that the convenience of operation from a district heating plant is an economic advantage. And in order that we may be of assistance to the consumers in assuring them satisfactory and economic operation from the central station, there must be perfect co-operation.

This co-operation should exist primarily between the producer and consumer; second, complete co-operation should exist between the district heating company, the architect and the steam fitter. A customer is helpless in regulating his steam consumption satisfactorily in so far as his ideas are concerned, if the heating system has not been properly designed and installed. Heating engineers, inexperienced with operating conditions from central station service, very often design plants which are not adapted to those conditions.

In order to eliminate these differences which may exist, the district heating company should have in its employ, an engineer who could either design for the customer or assist the architect in designing a system best adapted to local conditions. Then, too, during the course of installation he should have the power, as inspector, and be authorized to suggest such changes, during construction, as would be necessary for the betterment of the heating plant. This would place the entire responsibility for the installation of a perfect system, with the utility company. There it rightfully belongs, since the company desires to insure the customer of economical operation and satisfactory service.

SUPERVISION ESPECIALLY NECESSARY WITH ATMOSPHERIC AND VAPOR SYSTEMS.

It is now, perhaps, even more important that the utility company have supervision of piping in customers buildings, since the advent of the atmospheric and vapor systems of heating. The Atmospheric system of heating differs quite largely from the old style one or two-pipe installations, due to the fact that a much lower pressure is maintained in the piping. That necessarily reduces the velocity of flow. With the velocity decreased it is essential that the sizes of supply mains and risers be increased, thus permitting the required volume of steam to be carried to the heating units. The return piping, being free from any pressure other than atmospheric, must have the proper size and slope in order that perfect drainage of the system may exist.

The chief source of faulty installations arises from the fact that the steam fitter uses his personal knowledge and experience of former years, and disregards the ample pipe sizes and proper slope of mains, necessary with the Atmospheric system. Then, too, it is important that the district heating company have direct supervision to protect the owner against either unscrupulous or ignorant steam fitters.

A TYPICAL INCIDENT.

The following incidents relative to a certain Atmospheric installation will demonstrate the results of lack of cooperation:

The radiation had been figured by a reliable boiler company, and figured amply strong, but the steam fitter was allowed to use his own discretion as to pipe sizes. He ran ¾ in. supply risers to the second floor radiators and in some cases used 1 in. arms about 15 ft. long without dripping them, and with very little fall. He also used ½ in. return risers and in some cases even used ½ in. return mains. In addition to this it developed that in a great many cases the pipes were not reamed at all after being cut off with a three-wheel cutter. The result being that the second floor radiators did not heat at all and the first floor radiators gave very indifferent service.

The contract also called for a drip trap on the end of the service. The steam fitter convinced the customer that this drip trap was entirely unnecessary, but failed to make any allowance in the contract price for same.

When this job was completed, as the customer supposed, the steam fitter collected his money. Several weeks later, when the steam was turned on, it was found that there was no receiving tank on the system. Meanwhile, the steam fitter had gone out of business and another fitter was secured who put in the receiving tank, but who charged $50.00 for his work. The job did not work satisfactorily and the utility company, probably out of deference to the steam fitter, failed to notify the customer as to the cause of the trouble or to prescribe a remedy. Even with sufficient radiation and good pressure on the line, several times it was necessary for the customer to fire his hot air furnace, which luckily had not been removed.

Many such instances as that stated above occur daily, in buildings connected to district heating companies' systems where the companies do not give personal supervision to the installation of customers' piping, and show the necessity of co-operation between the utility company, the consumer, the engineer and the steam fitter in order that a system may be economically installed and operated and the convenience of an "up-to-date" system, supplied from central station service, enjoyed.

VALUE OF ENGINEERING RESEARCH DEPARTMENTS.

The best results have been obtained by companies who maintain an extensive engineering research department, the duties of which are three fold:

First: To do research work, making tests of various specialties, devices and heating systems.

Second: To design plans and make specifications for customers' heating systems, embodying recommendations resulting from the various tests. The district heating company is best fitted to design an economical system for any particular condition. This also relieves the architect of the responsibility and in some cases the necessity of obtaining an engineer to do the work, and at the same time collect his commission on the contract. The owner is freed from the difficult task of choosing a satisfactory heating system from a number of plans submitted by various engineers. He perhaps is not capable of choosing from the merits of each, but rather is influenced by the cash value attached.

Third: To have direct supervision of installation of customers' piping. As a result of this, piping of the proper size and slope will be installed and insure a good circulation of steam which is the chief requisite for the up-building of a satisfied customer. This method of inspection also protects the reliable steam fitter, who bases his contract price on a fair installation according to the plans, against the unscrupulous fitter who, without an inspector over him, would place a low bid and during construction disregard the plans and specifications, thus saving money wherever possible.

In localities where the above system of supervision exists, it meets with the hearty approval of the heating contractor and steam fitter, since it relieves them of all after responsibilities. When the work has once been accepted by the district heating company and the owner, the steam fitter is not subject to return calls for making repairs, which in general, are the result of ordinary usage. This is an item of great saving to the contractor, due to the fact, that they are called upon time and again, to virtually maintain a system during the first heating season after installation.

The results and benefits of this system are far reaching and effective, since through co-operation, satisfactory service is guaranteed which in turn, will extend the mains from the district heating plant.

District Heating Companies in the United States

One of the features of the recent convention of the National District Heating Association was the exhibit of a map of the United States, showing all of the district heating companies, with symbols to indicate whether they are steam plants or hot water plants. The map also indicates the states in which district heating is under the control of state utility commissions.

H. C. Kimbrough, Western manager for the American District Steam Company, is the compiler of the map which, it is stated, is up-to-date in every particular.

STATES HAVING COMMISSION CONTROL.

It was shown that the states having commission control for district heating are:

California.
Connecticut.
Idaho.
Illinois.
Indiana.
Kansas.
Maryland.
Massachusetts.
Missouri.
Montana.
Nevada.
New Hampshire.
New Jersey.
New York.
Ohio.
Oklahoma.
Oregon.
Pennsylvania.
Rhode Island.
Vermont.
Virginia.
West Virginia.
Wisconsin.

There are in all no less than 401 central station heating plants shown on the map, 351 of which are steam and 50 hot water. They are distributed as follows:

It should be noted that the plants listed include many installations that supply heat to more than one building, but which are not strictly district heating systems. As it was difficult, in some instances to draw the line, they have all been included.—EDITOR.

- Alabama
  - Birmingham (s.)
- Arkansas
  - Little Rock (s.)
- California
  - Oakland (s.)
  - San Diego, 2 (s.)
  - San Francisco, 3 (s.)
- Colorado
  - Boulder (s.)
  - Colorado Springs (s.)
  - Denver, 3 (s.)
  - Idaho Springs (s.)
  - Lamar (s.)
  - Pueblo (s.)
  - Walzenburg (s.)
- Connecticut
  - Bristol (s.)
  - New Haven (s.)
  - Unionville (s.)
- Georgia
  - Atlanta (s.)
- Idaho
  - Boise (h. w.)
  - Heyburn (s.)
- Illinois
  - Alton (h. w.)
  - Aurora (s.)
  - Belvidere (h. w.)
  - Bloomington (s.)
  - Canton (s.)
  - Carrollton (s.)
  - Champaign (s.)
  - Charleston (s.)
  - Chicago (s.)
  - Clinton (s.)
  - De Kalb (s.)
  - Danville (s.)
  - Decatur (s.)
  - Evanston (h. w.)
  - Galva (s.)
  - Galesburg (s.)
  - Hillsboro (s.)
  - Jerseyville (s.)
  - Kewanee (s.)
  - Matoon (s.)
  - Monmouth (s.)
  - Morrisonville (s.)
  - Mt. Vernon (h. w.)
  - Mt. Carmel (h. w.)
  - Oak Park (h. w.)
  - Pana (s.)
  - Paris (h. w.)
  - Paxton (s.)
  - Pekin (s.)
  - Peoria (s.)
  - Pontiac (s.)
  - Quincy (s.)
  - Rockford (s.)
  - Springfield (h. w.)

  - Streator (s.)
  - Sycamore (s.)
  - Taylorville (s.)
  - Tuscola (s.)
  - Urbana (s.)
  - Virden (s.)
  - Watseka (h. w.)
  - Waukegan (h. w.)
- Indiana
  - Alexandria (h. w.)
  - Amo (s.)
  - Anderson (s.)
  - Batesville (s.)
  - Bedford (h. w.)
  - Bloomington (s.)
  - Boonville (h. w.)
  - Brazil (s.)
  - Connersville (s.)
  - Crawfordsville (h. w.)
  - East Chicago (s.)
  - Elwood (h. w.)
  - Evansville (s.)
  - Fowler (h. w.)
  - Frankfort (h. w.)
  - Huntington (s.)
  - Indianapolis, 2 (s.)
  - Kokomo (s.)
  - La Porte (h. w.)
  - Lafayete (h. w.)
  - Lebanon (h. w.)
  - Logansport (s.)
  - Marion (h. w.)
  - Martinsville (s.)
  - Mooresville (h.w.)
  - Muncie (s.)
  - New Castle (s.)
  - Noblesville (s.)
  - Peru (h. w.)
  - Princeton (h. w.)
  - Rochester (s.)
  - Shelbyville (s.)
  - South Bend (s.)
  - Terre Haute (h. w.)
- Iowa
  - Ackley (s.)
  - Albia (s.)
  - Bedford (s.)
  - Boone (h. w.)
  - Britt (s.)
  - Burlington (s.)
  - Carroll (h. w.)
  - Cedar Rapids (s.)
  - Centerville (s.)
  - Clarinda (s.)
  - Cresco (h. w.)
  - Des Moines (s.)
  - Dubuque (s.)
  - Eagle Grove (s.)
  - Eldora (s.)
  - Grinnell (s.)
  - Grundy Ctr. (s.)
  - Hampton (s.)
  - Ida Grove (h. w.)
  - Iowa Falls (h. w.)
  - Lamoni (s.)
  - Leon (s.)
  - Manchester (s.)
  - Marion (s.)
  - Mason City (h. w.)
  - Missouri Valley (s.)
  - Oskaloosa (h. w.)
  - Ottumwa (s.)
  - Perry (h. w.)
  - Red Oak (h. w.)
  - Shenandoah (s.)
  - Sidney (s.)
  - Sioux City (s.)
  - Spirit Lake (s.)
  - Story City (s.)
  - Traer (s.)
  - Vinton (s.)
  - Webster City (s.)
- Kansas
  - Fort Scott (s.)
  - Leavenworth (s.)
  - McPherson (s.)
  - Sabetha (s.)
  - Salina (s.)
  - Topeka (s.)
  - Wichita (s.)
  - Wilson (s.)
- Kentucky
  - Jenkins (s.)
  - Louisville (s.)
  - Paducah (s.)
- Maryland
  - Baltimore (s.)
  - Cumberland (s.)
  - Port Deposit (s.)
- Massachusetts
  - Boston, 3 (s.)
  - Lynn (s.)
  - Pittsfield (s.)
  - Springfield (s.)
  - Westfield (s.)
  - Worcester (s.)
- Michigan
  - Adrian (s.)
  - Battle Creek (s.)
  - Decatur (s.)
  - Detroit (s.)
  - Grand Rapids, 2 (s.)
  - Houghton (s.)
  - Lansing (s.)
  - Virginia (s.)
  - Wadena (s.)
  - Winthrop (s.)
- Missouri
  - Excelsior Springs (s.)
  - Kansas City, 2 (s.)
  - Kirksville (h. w.)
  - Maryville (s.)
  - Mexico (s.)
  - St. Joseph (s.)
  - St. Louis (s.)
  - Sedalia (s.)
  - Springfield (s.)
- Montana
  - Billings (s.)
  - Butte (s.)
  - Glendive (s.)
  - Havre (s.)
  - Miles City (s.)
  - Missoula (s.)
- Nebraska
  - Auburn (s.)
  - Arlington (s.)
  - Aurora (s.)
  - Chadron (s.)
  - Clay Center (s.)
  - Crawford (s.)
  - Geneva (s.)
  - Harvard (s.)
  - Lincoln, 2 (s.)
  - McCook (s.)
  - Norfolk (s.)
  - O'Neill (s.)
  - Scottsbluff (s.)
  - Sidney (s.)
  - Wilber (s.)
  - Wisner (s.)
  - York (s.)
- New Hampshire
  - Exeter (s.)
  - Nashua (s.)
- New Jersey
  - Atlantic City
- New York
  - Auburn, 2 (s.)
  - Brooklyn (s.)
  - Clifton Spgs. (s.)
  - Dunkirk (s.)
  - Fredonia (s.)
  - Garden City (s.)
  - Geneva (s.)
  - Hilton (s.)
  - Hornell (s.)
  - Ithaca (s.)
  - Lockport (s.)
  - Newark (s.)
  - Newburgh (s.)
  - New York, 2 (s.)
  - Niagara Falls (s.)
  - Orangeburg (s.)
  - Penn Yan (s.)
  - Port Jefferson (s.)
  - Poughkeepsie (s.)
  - Rochester (s.)
  - Troy (s.)
  - Waterville (s.)
- North Dakota
  - Bismarck (s.)
  - Dickinson (s.)
  - Enderlin (s.)
  - Fargo (s.)
  - Grand Forks (s.)
  - Jamestown (s.)
  - Kenmare (s.)
  - Langdon (s.)
  - Mandan (s.)
  - Minot (s.)
- Ohio
  - Ada (s.)
  - Barberton (s.)
  - Bowling Green (h. w.)
  - Canton (s.)
  - Cincinnati, 2 (s.)
  - Cleveland, 3 (s.)
  - Columbus (h. w.)
  - Coshocton (h. w.)
  - Dayton, 2 (s.)
  - Delavare (h. w.)
  - Elyria (s.)
  - Fremont (h. w.)
  - Leipsic (s.)
  - Lima (s.)
  - Miami City (h. w.)
  - Middletown (h.w.)
  - New Philadelphia (s.)
  - Oberlin (s.)
  - Ottawa (s.)
  - Piqua (h. w.)
  - Springfield (s.)
  - Tiffin (s.)
  - Toledo, 3 (h. w.)
  - Troy (s.)
  - Washington Court House (h. w.)
  - Youngstown (s.)
- Oregon
  - Dallas (s.)
  - Portland (s.)
- Pennsylvania
  - Allentown (s.)
  - Altoona (s.)
  - Bangor (s.)
  - Bloomsburg (s.)
  - Bolivar (s.)
  - Cambridge (s.)
  - Chester (s.)
  - Clearfield (s.)
  - Coatesville (s.)
  - Bellefonte (s.)
  - Easton (s.)
  - Ebensburg (s.)
  - Erie, 2 (s.)
  - Germantown (s.)
  - Gettysburg (s.)
  - Grenville (s.)
  - Hanover (s.)
  - Harrisburg (s.)
  - Hazleton (s.)
  - Holmesburg (s.)
  - Johnstown (s.)
  - Lebanon (s.)
  - Lincoln (s.)
  - Lock Haven, 2 (s.)
  - Mt. Pleasant (s.)
  - Mahanoy City (s.)
  - Meyersdale (s.)
  - Montrose (s.)
  - Norristown (s.)
  - Overbrook (s.)
  - Oxford (s.)
  - Philadelphia, 2 (s.)
  - Pittsburgh, 3 (s.)
  - Philipsburg (s.)
  - Pottsville (s.)
  - Reading (s.)
  - Renova (s.)
  - Scranton, 2 (s.)
  - Shenandoah (s.)
  - Spring Grove (s.)
  - Towanda (s.)
  - Tyrone (s.)
  - Vandergrift (s.)
  - Washington (s.)
  - Wayne (s.)
  - West Chester (s.)
  - White Haven (s.)
  - Wilkes-Barre (s.)
  - Wilkinsburg (s.)
  - Williamsport (s.)
  - Windber (s.)
  - York (s.)
- Rhode Island
  - Pawtucket (s.)

Providence (s.)
South Dakota
Brooklings (s.)
Mobridge (s.)
Rapid City (s.)
Virginia
Clifton Forge (s.)
Utah
Salt Lake City (s.)
Virginia
Clifton Forge (s.)
Washington
North Yakima (s.)
Seattle (s.)
Spokane (s.)
Tacoma (s.)
Lapeer (s.)
Sault Ste. Marie (s.)
Saginaw (s.)
Minnesota
Ada (s.)
Albert Lea (h. w.)
Alexandria (s.)
Buhl (s.)
Canby (s.)
Crookston (s.)
Detroit (s.)
Duluth (s.)
Eveleth (s.)
Glenwood (s.)
Hibbing (s.)
Jordan (s.)
Keewatin (s.)
Mapleton (s.)
Marshall (s.)
Minneapolis, 2 (s.)
New Ulm (s.)
Mora (s.)
Owatonna (h. w.)
St. Paul, 3 (s.)
Springfield (s.)
Staples (s.)
Wisconsin
Beaver Dam (s.)
Berlin (s.)
Burlington (s.)
Hartford (s.)
Kenosha (h. w.)
La Crosse (h. w.)
Milwaukee, 5 (s.)
Mineral Point (s.)
Sturgeon Bay (s.)
Waukesha (s.)
West Bend (s.)
Wyoming
Casper (s.)
Cheyenne (s.)
Evanston (s.)
Laramie (s.)
Canada
Berlin (s.)
Brandon (s.)
Chatham (s.)
Dundas (s.)
Kingston (s.)
London (s.)
Montreal (s.)
Toronto (s.)
Winnipeg (s.)

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The Care of a Vacuum Heating System in the Summer Months

By H. S.

Many operating engineers in plants where vacuum heating systems are used are under the impression that a vacuum system does not need attention such as is required by the ordinary steam system during the off season, acting on the theory that because there is a vacuum on the system, all obstacles will thereby be overcome. However, a vacuum heating system requires a thorough looking over in the summer months, in order to keep it in the proper condition for efficiency and economical operation.

The most important point is to look over each return valve on the coils and radiators. They should be thoroughly cleaned by going around to each one, removing the interior and washing it off with hot water and soap or kerosene, to remove all grease and foreign matter which collect during the heating season. If the valves are of the thermostatic or expansion type, or float valves, they should be examined closely to ascertain if any of the containers or floats are cracked. If so, they should be replaced by new ones. These can usually be obtained from the manufacturers as they are nearly always guaranteed for five years' service.

All foreign matter should also be removed from the seat of the valve at the same time. The dirt pockets at the return header on the coils on loop seals and under differential valves should be thoroughly cleaned out. Remove all the foreign matter from the strainer at the vacuum pump and from any strainer at other points in the system—on Vento stacks, pipe coil heaters or on branch returns.

Pack all valve stems on the radiators and coils and particularly the valves on the returns and at the vacuum pump. Pack all flanges on the main return and install new gaskets or unions on the return mains.

The vacuum pump should have a thorough overhauling. The pistons should be examined, new packing installed and the valves reground. Any other points where air might leak in should be carefully examined.

Wherever vacuum systems are used in connection with street steam service, the service company should insist upon its customers taking care of any of the foregoing details for which they are responsible. The service company should also be very particular to see that all points in the main return where air might leak in, such as expansion joints, flanges, valves, etc., are carefully overhauled.

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Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

COMBINATION SYSTEM

Combining Power, Heating and Ventilation. Ira S. Evans. Ills. 4,000 w. Power—May 22, 1917. Serial, 1st part. Comparison of the usual blower system and a combination system. 20c.

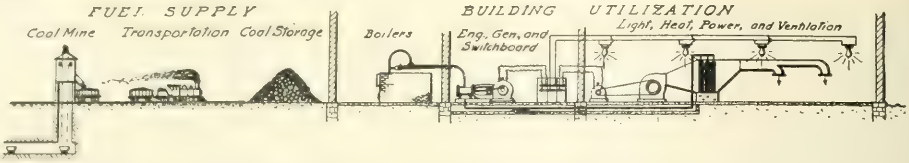
POWER PLANTS

Telephone and Telegraph Building Steam Power Plant. Warren O. Rogers. Ills. 2,000 w. Power—May 8, 1917. Office-building plant having features out of the ordinary. 20c.

◆

Air Moistener Co., Chicago, Ill., has appointed J. W. McAfee, consulting engineer, New York, as its sole selling agent for the eastern and southern states. Mr. McAfee will be glad to forward catalogues and quote trade discounts to the heating and ventilating trade. His headquarters are at 645 West 171st St., New York.

POWER PLANT ENGINEERING



Data for Selecting and Installing Power Boilers

Horizontal return tubular boilers are usually set in a brick setting with a fire wall, but without baffles. The products of combustion, created by burning coal on the grate, pass under the boiler shell to the rear, then forward through the tubes in the boiler shell to the front smoke box and out of the uptake into the chimney. A standard brick setting is shown in Fig. 1, this being used for all H. R. T. boilers by one of the most prominent engineering concerns and shows a setting which is guaranteed to prove satisfactory.

To provide for expansion of the boiler in the setting the front brackets are set on a bearing plate, but the rear brackets are placed upon rollers; a distance of 1 in. is then left between the rear of the shell and the brickwork.

When conditions render such a feature desirable it is entirely practical to arrange the setting of H. R. T. boilers with the smoke uptake located in the rear. This is accomplished by arranging another pass for the gases along the top of the boiler toward the rear, this pass being formed by arching the setting across the shell about 9 in. above the top and supporting the boiler by hangers from cross beams carried transversely over the top of the setting. This, in fact, is the method used and recommended by the Lukens Iron & Steel Co., one of the oldest tubular boiler manufacturers in the country.

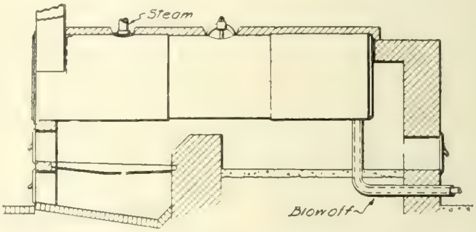


FIG 1. STANDARD BRICK SETTING.

THICKNESSES OF BOILER SHELLS FOR VARIOUS PRESSURES.

Diam. of Shell Inches	Thickness of Shell Inches	Allowable Working Pressures, Gauge, in Pounds per Square Inch, with Various Rivetings of Longitudinal Seams		
		Single	Double Staggered	Double Triple Butt Joint
42	9/32	84	103	
	5/16	93	114	
48	0.32	83	102	126
	0.36	94	115	141
54	0.36	83	102	126
	3/8	86	106	131
60	0.40	83	102	126
	0.42	87	107	132
66	0.43	81	100	123
	0.45	85	105	129
72	0.45	78	96	118
	0.48	83	102	126
78	0.45	72	88	109
	0.50	80	98	121
84	0.45	67	82	101
	0.50	74	91	112

REQUIRED THICKNESS OF METAL.

To compute the required thickness of shell for any given pressure the formula used is that for the rupture of cylinders subjected to interval pressure, viz.:

$$X\% \text{ of } t = \frac{P \times R}{S}$$

to which is added about ⅛ in. for corrosion and deterioration.

When t = the required thickness in inches.

R = the radius of the shell in inches.

P = the working pressure in pounds per square inch (guage).

S = the allowable stress in the metal in pounds per square inch (tensile strength ÷ 5 for factor of safety).

X% = the probable efficiency of the riveted joint, use 57% for single riveting, 70% for double staggered riveting, 86% for triple riveting.

The heads are usually made from plate 1/16 in. thicker so that a 48-in. boiler triple riveted at 100 lbs. working pressure would be computed as follows:

$$0.86\ t = \frac{100 \times 24}{11{,}000}$$

HORSEPOWER OF H. R. T. BOILERS.

Dia. of Shell, In.	Size, In.	Tubes No.	Length Ft.	Heating Surface, Sq. Ft.	H. P.
42	3	34	8	253	25.3
	3	34	9	284	28.4
	3	34	10	314	31.4
	3	34	11	344	34.4
	3	34	12	374	37.4
	3	34	13	405	40.5
	3	34	14	435	43.5
	3	34	15	465	46.5
	3	34	16	495	49.5
48	3	50	12	526	52.6
	3	50	13	569	56.9
	3	50	14	612	61.2
	3	50	15	654	65.4
	3	50	16	697	69.7
	3	50	17	740	74.0
	3	50	18	782	78.2
54	3	62	14	749	74.9
	3	62	15	801	80.1
	3	62	16	840	84.0
	3	62	17	905	90.5
	3	62	18	958	95.8
	3	62	19	1010	101.0
	3	62	20	1062	106.2
60	3	72	14	866	86.6
	3	72	15	927	92.7
	3	72	16	987	98.7
	3	72	17	1047	104.7
	3	72	18	1108	110.8
	3	72	19	1168	116.8
	3	72	20	1228	122.8
66	3	98	14	1146	114.6
	3	98	15	1236	123.6
	3	98	16	1306	130.6
	3	98	17	1386	138.6
	3	98	18	1466	146.6
	3	98	19	1546	154.6
	3	98	20	1627	162.7
	3	98	21	1707	170.7
	3	98	22	1787	178.7
72	3	124	14	1427	142.7
	3	124	15	1527	152.7
	3	124	16	1626	162.6
	3	124	17	1726	172.6
	3	124	18	1826	182.6
	3	124	19	1926	192.6
	3	124	20	2025	202.5
	3	124	21	2125	212.5
	3	124	22	2225	222.5

$$T = \frac{100 \times 24}{0.86 \times 11{,}000} = \tfrac{1}{4} \text{ in. which, with}$$

1/8 in. added, gives a 3/8 in. shell and a 3/8 in. + 1/16 in. or 7/16 in. head.

The city of Philadelphia requires the thickness of shell shown on page 50 for various pressures with 55,000 lbs. tensile strength of steel.

The bracing of the heads is accomplished by the expanding of the tubes into the lower portion and by rods or diagonal braces above the tubes. The matter of bracing is often left to the manufacturer with the stipulation of the working pressure and a test pressure of 25% in excess of the working pressure.

SIZES AND RATINGS.

In rating horsepowers for H. R. T. boilers it is conservative to allow 10 sq. ft. of heating surface per horsepower, heating surface being all the surface of the boilers with water or steam on one side and the fire or gases of combustion on the other. In the H. R. T boiler this consists of the area of the tubes, front and rear heads and the lower half of the outside of the shell.

The table on page 51 gives the horsepower for various sizes of H. R. T. boilers.

H. R. T. boilers are sometimes set with the smoke box overhanging at the front. Such an arrangement is not desirable as it hinders the fireman in his work close to the fire and ash doors. The blow-off pipe is taken from the rear of the boiler and carried out of the setting by passing through the space in which the gases are travelling. This pipe should be protected from the excessive heat and action of the gases by a baffle or covering of substantial sort; a special asbestos sleeve is manufactured for this particular purpose.

Where the steam is taken off of the boiler a dry pipe will give the best results, this consisting of two pieces of perforated pipe one size smaller than the steam nozzle and extended two or three feet along the inside of the shell as close to the top as possible. Sometimes a baffle plate is placed below the pipe to prevent water being drawn up into it.

PORTABLE STEEL FIRE BOX BOILERS.

A fire-box tubular boiler of the portable type is shown in Fig. 2. The feed water enters this type through the flange in the water leg at the rear of the fire box and just above the ash pit. It gradually ascends in the boiler as it becomes heated, finally becoming vaporized and passing out through the steam nozzle. Based on 10 sq. ft. of heating surface per horsepower the following dimensions cover the various sizes:

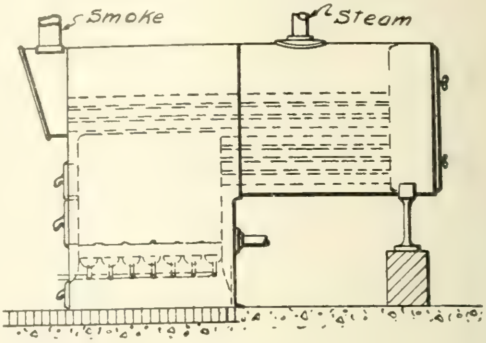


FIG. 2—PORTABLE FIRE-BOX TUBULAR BOILER.

HORSEPOWER OF PORTABLE STEEL BOILERS.

Diam. of Boiler In.	Length of Boiler	Width of Boiler	Heating Surface Sq. Ft.	Horse-power
30	5′-5″	2′-6″	75	7.5
	6′-5″	"	89	8.9
36	5′-11″	3′-0″	118	11.8
	6′-5″	"	128	12.8
	7′-0″	"	146	14.6
42	6′-8″	3′-6″	187	18.7
	7′-8″	"	219	21.9
	8′-7″	"	248	24.8
48	8′-3″	4′-0″	281	28
	9′-2″	"	320	32
	10′-9″	"	375	38
54	9′-8″	4′-6″	422	42
	10′-9″	"	477	48
	11′-9″	"	528	53
60	12′-1″	5′-0″	583	58
	13′-3″	"	642	64
	14′-0″	6′-8″	701	70
	15′-10″	"	804	80
66	15′-5″	7′-2″	905	90
	17′-0″	"	1003	100
72	15′-7″	7′-8″	1202	120
	17′-2″	"	1234	123

BRICKSET STEEL FIREBOX BOILERS.

Another type of fire box boiler which is brick set is shown in Fig. 3, the smoke outlet being on the rear in this case. Here all the gases pass through the tubes to the rear smoke box but do not return toward the front through tubes, travelling instead on the outside of the shell along the lower half for the length of the baffle located approximately on the center line of the boiler and extending front almost to the rear of the fire box. Passing around the end of the baffle the gases travel toward the rear again along the top of

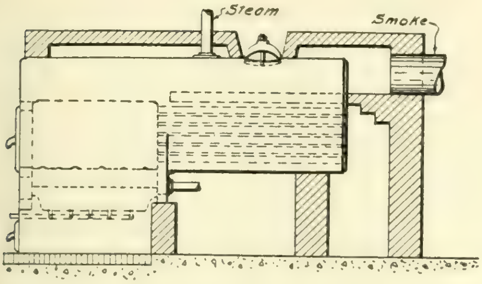


FIG. 3—BRICKSET FIREBOX BOILER, WITH SMOKE OUTLET AT THE REAR.

the shell (between the arched top of the setting and the shell) to the smoke outlet.

HORSEPOWER OF BRICK-SET FIRE-BOX TUBULAR STEEL BOILERS.

Diam. of Boiler, In.	Length Overall	Width of Boiler	Horse-power
30	6′-6″	5′-7″	7.5
	7′-6″	"	8.3
	8′-6″	"	10
36	7′-6″	6′-1″	12
	9′-0″	"	14
	10′-6″	"	18
42	8′-6″	6′-7″	19
	10′-0″	"	21
	11′-6″	"	24
48	10′-6″	7′-2″	27
	12′-0″	"	32
	13′-6″	"	37
54	14′-0″	7′-8″	41
	16′-6″	"	49
60	15′-6″	8′-2″	60
	18′-0″	"	71
66	16′-0″	9′-0″	78
	18′-0″	"	88
72	16′-0″	10′-0″	93
	18′-0″	10′-0″	107

WATER-TUBE BOILERS.

Water-tube boilers may be of the more common type with a longitudinal drum as shown in Fig. 4 or may be of the cross drum style as illustrated in Fig. 5. In these boilers the gases traverse across the tubes several times being guided by fire-brick baffles laid on the tubes.

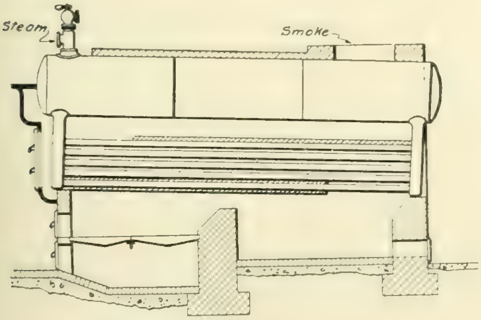


FIG. 4—WATER-TUBE BOILER WITH LONGITUDINAL DRUM.

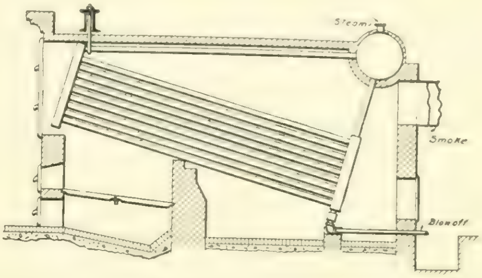


FIG. 5—WATER-TUBE BOILER OF CROSS DRUM TYPE.

The horsepower of longitudinal drum boilers runs approximately as follows:

HORSEPOWER OF WATER-TUBE BOILERS.

(Longitudinal Drums.)

Length of Boiler	Width of Boiler	No. of Tubes	Horse-power
16′-6″	7′-0″	46	66
"	7′-0″	59	83
20′-6″	7′-7″	53	100
"	7′-7″	68	125
"	8′-2″	77	167
18′-6″	8′-2″	94	150
20′-6″	8′-9″	86	155
"	8′-9″	105	187
"	9′-4″	95	170
"	9′-4″	116	205
"	9′-11″	104	187
"	9′-11″	127	225
"	10′-6″	138	250
"	10′-6″	163	286
"	11′-1″	149	249
"	11′-1″	176	308

Cross-drum boilers occupy slightly less space than the longitudinal drum type their dimensions for equivalent horsepowers being 6 in. to 12 in. less than the above lengths and widths.

BLOWOFF CONNECTIONS.

In providing for the blowoff on high pressure boilers additional safeguards are needed; the most approved practice demands a plug cock next to the boiler, then the regular blowoff valve and then a check valve between the blowoff valve and the blowoff header;

this is illustrated in Fig. 6. The purpose of the plug cock is to allow the blowoff valve to be repaired without shutting down the boiler and it is sometimes used as an auxiliary shut-off, being kept closed continuously except during the time of blowing down the boilers. The check valve serves as a double purpose, as it allows the blowoff valve to be repaired without interfering with the use of the blow-off main by other boilers and it prevents scalding a man inside of a boiler cut out for repairs and upon which the blowoff had been left open—a thing otherwise very likely to occur.

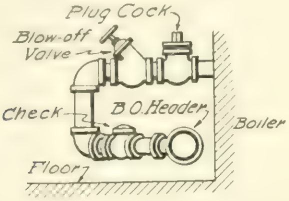


FIG. 6—APPROVED PRACTICE FOR BLOW-OFF CONNECTION.

Regardless of the size of the boiler the blowoff connection is seldom more than 2½ in. in size. Good practice requires the connection of the blowoffs from a battery of boilers into a 3 in. or 4 in. header through Y branches, the header terminating in a cast-iron or steel blowoff tank which is vented and where the heated water has a chance to cool before going into the drain to the sewer. The overflow to the sewer is taken from the bottom of the tank so as to secure the coolest water, all as shown in Fig. 7 which is a typical blowoff tank with its connections.

The size of the blowoff tank may be roughly checked by figuring its capacity so as to retain all the water delivered when a boiler is blown down 3 in. below its previous water line.

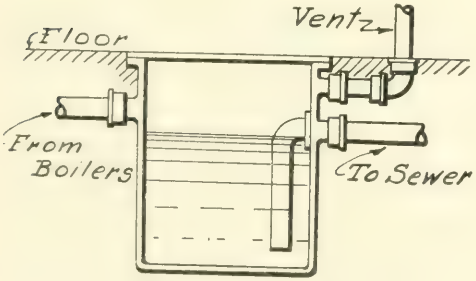


FIG. 7—TYPICAL BLOWOFF TANK AND CONNECTIONS.

Some localities require the use of a cooling coil in a blowoff tank, the idea being that the fireman will turn on the cold water before blowing down and thus cool the boiler water. In reality such coils do little good as they are seldom operated properly.

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The boiler horsepower required in a building power plant where the exhaust is used to heat the building is not necessarily determined by the maximum horsepower developed. Neither is it wholly determined by the heating load. The boilers must have capacity enough to carry the maximum power load or the maximum heating load, the greater demand being the one to actually consider in developing the necessary boiler capacity. Whenever the heating requirements are less than the amount of steam furnished by the engine exhaust, a make-up of high-pressure live steam direct from the boilers must be used, the pressure being reduced by passing it through a reducing valve, but when the heating load is less than the amount of exhaust steam supplied by the engine the surplus steam must escape through a back-pressure valve and free exhaust to the atmosphere.

NEW POWER PLANT OF THE DETROIT EDISON COMPANY.

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Detroit, Mich.—The accompanying illustration shows the new power plant of the Detroit Edison Company, at Connor's Creek, Detroit. It is claimed for this building that in construction and equipment it surpasses any other building of its kind in the United States or abroad.

The War and the Heating Engineer

National Committee Appointed on Health of Employees.

An important movement has been inaugurated by the National Defense Advisory Council in appointing a committee on the health of employees, with Dr. William A. Evans, of Chicago, as chairman. A section of this committee will be devoted to industrial hygiene, with Dr. E. R. Hayhurst as chairman. One of the sub-committee of the industrial hygiene section will devote itself to ventilation, including heating. The members of this sub-committee are Professor C. E. A. Winslow, D. D. Kimball and Rudolph Herring. This and the other sub-committees are to submit both standards and recommendations (for the time being essentials only) covering the subject assigned to it and to arrange to conform to the following:

1. Items so vital that they should be embodied in contracts which the government makes with manufacturers or others.
2. Items of second importance, to be brought to the attention of manufacturers, and in some instance to laborers, also eventually to be made laws, these to be transmitted within one month.
3. Items of third importance, to be made the subject of educational propaganda, to be transmitted at a more subsequent date.

The general order of application of standards and recommendations to be, first, for those industries making high explosives, next arms and ammunitions, next heavy war machinery, and thereafter other industries engaged less directly in the military preparations, and eventually, possibly to all industries.

Heating Men in Military Service.

A partial list has been compiled by *Domestic Engineering,* Chicago, of men engaged in the heating and plumbing trades who are now in the National Guard, either as officers or privates, or who may be called upon to serve Uncle Sam in the war with Germany. Among these are the following:

Adjutant-General William T. McGurrin, of the heating and plumbing firm of Sproul & McGurrin, Grand Rapids, Mich., who has seen many years of service with the Michigan National Guard.

Major Edward Bittel, 1st Regiment, Illinois National Guard, formerly a heating and plumbing contractor in Chicago.

Major William H. Chenoweth, manager of the Chicago branch of Warren Webster & Co., serving with the Illinois National Guard.

Captain Robert H. Smith, a Chicago heating and plumbing contractor, captain of Company D, First Regiment, Illinois National Guard.

Lieutenant-Commander and Paymaster G. C. Hall, treasurer of the McRae & Roberts Co., Detroit, serving with the First Battalion of the Michigan Naval Militia.

Captain William D. Bucklin, Chicago, sales manager for the Fulton Co., Knoxville, Tenn., formerly attached to the coast artillery of the Rhode Island National Guard.

Colonel Edward McGowan, president and founder of the McGowan Plumbing Co., Memphis, Tenn., who saw service in the Spanish-American War. Now engaged in promoting recruiting in Memphis.

Lieutenant A. Gloeckner, of Gloeckner & Melville, heating and plumbing contractors, St. Louis, Mo., attached to Company A, First Regiment, Missouri National Guard.

In addition to the foregoing, New York City is represented by a number of men in the trade, prominent among whom is Lieutenant William G. LeCompte of Jenkins Bros., New York, who is on service "somewhere in New York State" with the Seventh Regiment, New York National Guard.

A. M. Maddock, president of Thomas Maddock & Sons Co., Trenton, N. J., has been commissioned captain in the United States Army, in connection with his services as chairman of the Committee to Supply Sanitary Equipment for Concentration Camps.

M. M. Cochrane and H. H. Sargent, president and treasurer, respectively of the Cochrane-Sargent Co., St. Paul, Minn., have joined the Officers' Reserve Camp at Fort Snelling, Minn.

Charles L. Collette, advertising manager of the Kewanee Boiler Co., Kewanee, Ill., has joined the officers' training camp at Fort Sheridan, Ill.

Albert Wallace Hills, manager of the Chicago branch of the Haydenville Co., Haydenville, Mass., has enlisted as gunner on a scout-patrol boat of the mosquito fleet.

H. A. Voss, chief clerk; C. G. Dennison, assistant credit manager; E. H. Locke and A. T. Burr, all of the American Radiator Company, are in training at Fort Sheridan, Ill., for the Reserve Officers' Corps. Among other men connected with this company who are now in government service are N. Coltrin, militia; C. S. Gardiner, engineering corps; Robert Salvage, militia; H. R. Wesley, engineering corps; H. F. Straw, navy; and Eugene Willoughby, engineering corps.

Thomas F. Manville, president of the H. W. Johns-Manville Co., New York, has been appointed chairman of the Co-Operative Committee on Asbestos, Magnesia and Roofing, of the Advisory Commission of the Council of National Defense.

Readers of THE HEATING AND VENTILATING MAGAZINE are requested to send in additional names of members of the craft who are already called out or who are at present in military organizations that are likely to see active military service. The additions to the list will be published as received under the permanent heading of "Heating Men in Military Service."

Adjusting the Government's War Purchasing Machinery.

How government specifications are being changed to meet practical war conditions; how sources of supplies are being surveyed and developed to satisfy a demand heretofore unheard of; and how conclusions are being reached as to fair and reasonable prices; are questions gone into in the first of a new series of war bulletins. They are to be prepared under the direction of Waddill Catchings, of New York, just appointed an assistant to the director of the Council of National Defense. Mr. Catchings is also the chairman of a new committee of the Chamber of Commerce of the United States to cooperate with the council. The series will be issued through the National Chamber for the purpose of placing before business men authoritative statements regarding government activities in procuring materials and supplies for the war.

Effective work has been accomplished, it is said, in adapting peace-time government specifications to immediate needs. A difficulty immediately apparent was that they were prepared years ago for our small army in time of peace and fell far short for the present necessities of a million or more men. For example—the glove specifications called for a seamless glove, of which not more than 500,000 could be made by all the equipment in the United States in a year. The men in the trade readily pointed out how on changing the specifications, an equally satisfactory glove could be manufactured by existing equipment in quantities to meet the requirements of millions of men.

At a conference between army engineers and fifteen chief engineers representing the principal truck manufacturers of the United States, a standard specification was adopted for trucks for war service and a definite beginning made in standardizing the military truck. Such a meeting also resulted in coöperation between manufacturers in the designing and developing of die and tool equipment to avoid duplication of similar work in numerous factories.

Engineering Council Formed by United Engineering Society.

An important step was taken by the four large national engineering societies June 27 when the first meeting was held of the Engineering Council. This body is a department of the United Engineering Society. It is composed of 24 members, five being appointed by each of the founder societies and four by the United Engineering Society. The council, of which I. N. Hollis is president, discussed ways and means by which the founder societies through the council may be of use to the nation. A resolution was adopted instructing the executive committee to cooperate with the government in procuring the services of engineers, while a committee of three was named, consisting of H. W. Buck, A. M. Greene, Jr. and Edmund B. Kirby, to consider the best means of utilizing the inventive ability of members of the founder societies.

Duties and Opportunities Presented to American Manufacturers by the War.

Modern war creates tremendous activity—it calls into use every material resource of a country—its whole machinery of production and distribution. A little over two years of world war have brought to this country a volume of business, the like of which we have never before known. Our power to produce has been taxed to the limit. Constructive effort—constructive selling—has often had its mettle tested during that time. Greater opportunities—greater tests are at hand.

Since it has been true that with our country at peace our prosperity has been unprecedented, what will it be with our country at war, with every effort being put forth to win? Billions of dollars bonds have been voted to pay for huge purchases of supplies. The billions of dollars provided for in the joint loan and revenue budget of the government are equal to the total value of our enormous export trade during the past 18 months. The effect of putting this huge sum into circulation will be colossal. Its effect upon factories, warehouses, arms of transportation, are almost inconceivable at the moment.

Prosperity in all industries producing the necessaries of life—food, clothing, munitions, utensils and supplies, will be limited during the next twelve months only by capacity to produce and transport. Industries producing the non-essentials may languish. From them both capital and labor may be diverted.

The farmer will produce mammoth crops. He will need quantities of wagons, trucks, plows, harrows, reapers, tractors and binders. And he will have the money to pay for them. His annual cash income has lately averaged about $1,500. The government estimates that in the next twelve months it will be $2,500. Think of the purchasing power of 6,500,000 farms.

Will American business men be ready? Will they have the factory and storage capacity, the transportation facilities, to take care of this flood tide of business? Will they prepare constructively on a scale which will give full play to output with minimum waste? Or, will they drift day by day from hand to mouth in a spirit of shortsighted fear and wait for the deluge to engulf them?

THE TIME TO BUILD IS NOW, BEFORE MATERIALS RUN SHORT, TRANSPORTATION BECOMES STILL MORE CONGESTED AND LABOR IS DRAFTED INTO MILITARY SERVICE.—*J. P. Bock, before the World's Salesmanship Congress.*

Stenographers Needed by Government.

The United States government is in urgent need of great numbers of stenographers and typewriters, both men and women, for service in the departments at Washington, and the situation in federal offices outside of Washington is scarcely less urgent, according to an official notice received from John A. McIlhenny, president of the United States Civil Service Commission. Examinations for the departmental service in Washington for both men and women are held every Tuesday in 400 of the principal cities. Examinations for the field service (positions outside of Washington) are held frequently. The usual entrance salaries range from $900 to $1200 a year. Applicants must have reached their eighteenth birthday on the date of examination. Full information, etc., will be mailed on application to the United States Civil Service Commission, Washington, D. C., or to the secretary of the United States Civil Service Board of Examiners in Boston, Philadelphia, Atlanta, Cincinnati, Chicago, St. Paul, Seattle, San Francisco, New York, New Orleans and St. Louis.

Statistics of the Heating Industry in the United States

Inquiries received from time to time as to the amount of capital invested in the heating industry in the United States, the value of the annual output and other items have largely gone unanswered, except in the most general terms, due to a lack of definite information on the subject. This information has now been supplied by the Government in a volume that has just been published by the Department of Commerce, entitled, "Abstract of the Census of Manufacturers, 1914," but actually taken in 1915.

The volume, which contains no less than 720 pages, gives, for 340 separate manufacturing industries, statistics relating to number, size and character of ownership of establishments and States in which located; proprietors, officials, salaries, employees and wage earners; salaries and wages paid, power used, fuel consumed, cost of materials, value of products, quantities of principal products and various other items.

The meat of the volume is contained in four general tables which assemble the more important data in convenient form. That part of the table referring to the manufacture of steam fittings and steam and hot water heating apparatus is given herewith as Table 1. In studying Table 1 it should be noted that the establishments included in this industry manufacture principally steam and hot water radiators, safety valves, engine indicators, pressure and vacuum gauges, water gauges, hydrants and cocks, coils and bends of iron, brass and copper pipe, unions and flanges, and similar fittings. The manufacture of stoves and furnaces, including doubtless some hot water heaters, is classified as a separate industry. There is considerable overlapping with the foundry and machine-shop industry and with some other industries.

Because of changes in classification, the figures for 1889 are not closely comparable with those for later censuses.

Radiators and cast-iron heating boilers to the value of $50,982 were reported by makers

TABLE 1—SUMMARY FOR STEAM FITTINGS AND STEAM AND HOT WATER HEATING APPARATUS.

	Number of establishments.	Wage earners (average number).	Primary horsepower.	Capital	Wages	Cost of materials	Value of products	Value added by manufacture
STEAM FITTINGS AND STEAM AND HOT-WATER HEATING APPARATUS.								
United States								
1914	295	26,388	38,630	$85,853,000	$16,738,000	$26,921,000	$63,922,000	37,001,000
1909	288	23,378	33,008	59,810,000	13,891,000	22,534,000	54,084,000	31,550,000
1904	176	11,690	10,696	28,541,000	6,582,000	10,425,000	24,911,000	14,486,000
1899	227	9,252	6,510	18,233,000	4,983,000	10,220,000	22,085,000	11,865,000
1889	217	10,645	7,224	17,017,000	6,204,000	10,628,000	23,147,000	12,519,000
1879	95	2,474	....	3,076,000	1,306,000	2,857,000	5,128,000	2,271,000
1869	59	1,141	239	1,606,000	854,000	1,424,000	3,425,000	2,001,000
1859	28	665	....	507,000	200,000	367,000	1,029,000	662,000
States, 1914								
California	4	15	24	61,000	15,000	25,000	56,000	31,000
Connecticut	14	3,371	5,297	8,752,000	1,922,000	2,706,000	6,454,000	3,748,000
Illinois	34	2,579	4,492	7,857,000	1,540,000	2,356,000	5,470,000	3,114,000
Indiana	8	513	841	1,523,000	336,000	519,000	1,147,000	628,000
Iowa	4	66	123	419,000	43,000	101,000	335,000	234,000
Massachusetts	21	3,175	2,810	7,365,000	2,019,000	2,019,000	5,910,000	3,891,000
Michigan	14	1,095	1,232	2,273,000	796,000	1,130,000	2,915,000	1,785,000
Minnesota	14	269	268	1,309,000	190,000	430,000	1,186,000	756,000
Missouri	7	533	776	2,334,000	370,000	584,000	1,320,000	736,000
New Jersey	12	622	960	1,986,000	421,000	692,000	1,722,000	1,030,000
New York	46	4,898	7,751	19,013,000	3,365,000	5,966,000	13,097,000	7,131,000
Ohio	33	2,414	3,979	7,451,000	1,546,000	2,305,000	6,315,000	4,010,000
Pennsylvania	57	5,747	8,246	21,600,000	3,475,000	6,705,000	14,999,000	8,294,000
Wisconsin	9	327	493	1,375,000	206,000	374,000	880,000	506,000
All other states[1]	18	764	1,338	2,535,000	494,000	1,009,000	2,116,000	1,107,000

[1] Includes: Alabama, 3 establishments; Colorado, 1; Delaware, 1; Kansas, 1; Maine, 1; Maryland, 1; New Hampshire, 1; Oregon, 1; Rhode Island, 3; Tennessee, 1; Vermont, 1; Virginia, 1; Washington, 2.

TABLE 2—SEPARATE DATA FOR THE HEATING INDUSTRY FOR 1914.

INDUSTRY	Number of establishments	Wage earners (average number)	Capital	Wages	Cost of materials	Value of products	Value added by manufacture
Steam fittings and steam and hot-water heating apparatus	295	26,388	85,853,000	16,738,000	26,921,000	63,922,000	37,001,000
Radiators and cast-iron heating boilers	89	10,341	34,657,000	7,033,000	9,601,000	23,477,000	13,876,000
All other	206	16,047	51,196,000	9,705,000	17,320,000	40,445,000	23,125,000
Stoves and hot-air furnaces	438	29,535	78,524,000	20,777,000	23,802,000	67,941,000	44,139,000
Stoves and ranges	286	25,304	67,243,000	17,685,000	18,642,000	55,108,000	36,466,000
Hot-air furnaces	141	4,042	10,844,000	3,002,000	4,791,000	12,081,000	7,290,000
Fireless cookers	11	189	437,000	90,000	369,000	752,000	383,000

of other steam fittings, and to the value of $1,482,532 by establishments assigned to other classifications, principally stoves and hot-air furnaces, structural ironwork, tools, electrical machinery, apparatus, and supplies and plumbers' supplies, not elsewhere specified.

"All other" steam fittings to the value of $2,414 were reported by makers of radiators and cast-iron boilers, and to the value of $53,873 by establishments assigned to other classifications, principally foundry and machine-shop products.

Table 2 presents separate data for 1914 for the two branches of the industry, "radiators and cast-iron heating boilers" and "all other" steam fittings, and for "stoves and ranges," "hot-air furnaces," and "fireless cookers."

Hot-air furnaces to the value of $1,907,712 were reported as made by manufacturers of stoves and ranges and to the value of $390,533 by establishments assigned to other classifications.

Copies of the "Census of Manufacturers" may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 65 cents a copy.

Death of John Bartlett Pierce.

John Bartlett Pierce, one of the founders of the American Radiator Company, and its vice-president, died at his home in Lynnfield, Mass., June 23. Mr. Pierce, who was also known as the founder of the radiator business in this country, was 73 years old. He left an estate valued at $5,000,000, $1,000,000 of which is to be divided among 400 of the older employees of the American Radiator Company, with further provisions giving them 60% of the income on $2,500,000, this principal also ultimately to be distributed among them with certain limitations. The employees who participate in the bequest must have been in the service of the company at least ten years at the time Mr. Pierce drew his will, in December, 1913.

A surplus caused by the limitation referred to is to be used for the establishment of the John B. Pierce Foundation for technical research in heating, ventilating and sanitation "to the end that the general hygiene and comforts of human beings and their habitations may be advanced."

The funeral services, which were held at the Pierce home, were attended by more than 2,000 persons, including representatives of the American Radiator Company from every city east of Kansas City. The pall-bearers included, C. K. Foster, W. H. Hill and Louis Bruch.

Important Changes in Methods of National Association of Master Plumbers.

The recent convention of the National Association of Master Plumbers, held in Evansville, Ind., June 18-20, marked the opening of a new era in that organization. The numerous government suits against members of the association have now all been settled by the payment of fines, while the resolutions under which the suits were brought have been definitely rescinded and the association has pledged itself to conduct its affairs in strict conformity with the course laid down by the government. There was some doubt, even, as to the propriety of issuing the association's "Red Book," containing a list of members, but this, it was decided, was permissible, provided copies of the "Red Book" are not distributed among manufacturers and others outside the association's membership.

Another action taken was the elimination of the office of State vice-president. These officers were cited by the government as one of the agencies through which the association exerted an unlawful influence upon the manufacturers.

The convention voted to meet next year in St. Louis.

Following are the new officers: President, L. McNamara, St. Louis; vice-president, F. B. Lasette, New York; treasurer, Charles J. Herbert; secretary, A. A. Zertanna.

National Association of Engineers.

At an adjourned meeting of the convention of the American Association of Engineers, held July 13, Edmund T. Perkins, of the Edmund T. Perkins Engineering Co., Chicago, was elected president. Following several stormy sessions of the convention over the proposed constitution, one was finally adopted. A resolution was also adopted forming a patriotic league of engineers which provides for a census of engineers and to look after the dependents of enlisted men. Co-operation with other engineering societies is to be fostered.

National Association of Sheet Metal Contractors.

An interesting feature of the recent convention of the National Association of Sheet Metal Contractors was the report of the warm air furnace committee. This breezy document reviewed the efforts made to have the University of Minnesota disavow the bulletin issued under its auspices by Professor J. L. Mowry, reflecting on the warm air furnace. It seems, however, that instead of doing so, the university loaned to the University of Missouri the plates used in the objectionable bulletin, and that the bulletin was republished by the University of Missouri word for word. "Up to this time," says the report, "The University of Minnesota seems to have done nothing to rectify its error."

The report also called attention to another "attack" on warm air heating contained in Bulletin 97, issued by the Bureau of Mines, Washington, D. C., and prepared by Professor L. P. Breckenridge and S. B. Flagg. (This bulletin was reviewed in THE HEATING AND VENTILATING MAGAZINE for November, 1915.)

The fact that *The Metal Worker,* of New York, republished "this budget of misinformation" is commented on in a way that brought the following rejoinder from Frank K. Chew, editor of *The Metal Worker:*

"The report of the committee indicates that a trade paper has printed something from the government reports which it should not have done. When you pay taxes to the United States Government for the various bureaus, and the Government selects the men who know most about the subjects upon which papers are written, it is necessary for a trade paper to take the Government document and lay before you the information contained therein, and it is the proper function of the trade paper to reflect what is being done. This is what was done in the particular instance mentioned in the report."

On the subject of the "pipeless" furnace the committee warned manufacturers and dealers against extravagant and misleading language in advertising and selling these furnaces.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Committee on Ship Ventilation at Work.

Visits to the Norfolk Navy Yard and to the Brooklyn Navy Yard have been made by the committee appointed by President Lyle, at the request of Admiral Taylor, chief of the Bureau of Construction and Repairs, Navy Department, to co-operate with the Department on the ventilation of battleships and submarines. The members of the committee are Walter S. Timmis, New York; Willis H. Carrier, New York; C. H. Dusold, New York; F. R. Still, Detroit and Dr. E. Vernon Hill, Chicago.

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New Publications.

The Economical Purchase and Use of Bituminous Coal for Heating Homes, with special reference to conditions in Illinois, is the title of a new bulletin issued by the Engineering Experiment Station of the University of Illinois. The point is made in the bulletin that if every householder and owner of a small house heating plant in the state of Illinois would use reasonable care in the purchase of his fuel and in the operation of his plant, the saving would be equivalent to 4,500,000 tons of coal. According to a circular just issued by the Engineering Experiment Station of the University of Illinois such a saving is easily within the range of practical attainment. Applied to the entire United States, intelligent attention in the operation of house heaters would save more than 60,000,000 tons of coal.

The University of Illinois has discussed, in the circular referred to, the more important factors involved in the installation of a satisfactory house heating system, and has set forth the most economical methods of firing soft coal and operating a house heating plant. The properties of fuels, and the processes attending their combustion are discussed in a fashion which is intended to help the average householder to understand his problem and to secure the economics of intelligent operation.

Tables giving the trade names, geologic names, and average heating value of the coals of the central western area are contained in the circular and a chart is presented to show the relative worth of coals of different heating values. Some attention is also given to the properties of eastern coals. Diagrams in color illustrate the usual heat losses which occur and suggest the means to be employed in overcoming them. Methods and devices for regulating house heaters are shown by drawings, and the importance of proper chimney height, of air-tight flues, and of various dampers and regulators is emphasized by a number of illustrations.

Copies of this circular may be had by addressing the Engineering Experiment Station, Urbana, Illinois. The price is ten cents.

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Trade Literature.

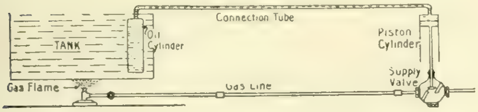
Kewanee on the Job, the title of a well-designed publication issued by the Kewanee Boiler Co., Kewanee, Ill., contains 40 pages of illustrations of buildings equipped with Kewanee boilers or other Kewanee equipment. This section is followed by a partial list of buildings heated with Kewanee smokeless boilers, arranged by States. The concluding section is devoted to "Kewanee—Its Products and Their Home." Contrasting views are shown of the company's works in 1892 and in 1917. These are followed by detailed views, cut away to show the construction features, of the Kewanee smokeless boilers, brickset and portable; the Kewanee boiler, brickset and portable; Kewanee radiators for steam or water; Kewanee garbage burners, Tabasco water heaters and Kewanee tanks. Size 8½ x 11 in. Pp. 80.

Beach-Russ Patented Vacuum Pumps for heating systems is the subject of a new bulletin (No. 20) which presents in concise form the essential data regarding the company's line of return line pumps, vacuum pumps for air-line vacuum systems, and the Beach-Russ automatic condensation pump receiver. Size 6 x 9 in. Pp. 4.

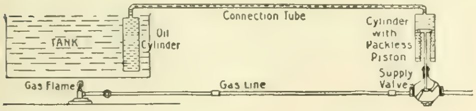
How Sarco Temperature Regulators Work is told in a circular recently issued by the Sarco Co., Inc., Woolworth Building, New York.

If a metal cylinder completely filled with oil is hermetically sealed and then heated, the oil will expand with such great force as to split the cylinder. This enormous pressure is utilized in the Sarco temperature regulator.

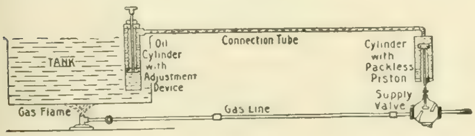
Referring to the illustration below, the oil cylinder communicates through a pipe with another cylinder in which there is a piston, the entire system being completely oil filled. The piston in the piston cylinder actuates a valve. If the oil cylinder is immersed in a tank containing the fluid, temperature of which is to be regulated and that tank is heated, say by a gas flame, the supply of gas to which is regulated by the supply valve, the mode of operation is obvious. When the temperature of the tank liquid rises, heating the oil in the oil cylinder, the expanding oil pushes the piston outward in its cylinder and closes down the supply valve, thus reducing the gas flame. If on the other hand the tank temperature falls the oil in the cylinder cools and contracts, thus allowing the piston in the piston cylinder to go back under the influence of a spring (not shown) opening the supply valve and thus turning the gas flange higher.



It is imperative that the piston packing be leak-proof, capable of withstanding the enormous pressures which are involved, and at the same time frictionless. Here the Sarco spirally corrugated tube comes into play, a section of the same being hermetically attached to the outer surface of the piston at one end, and to the inner skirt of the oil cylinder at the other end, as shown in the illustration below. The Sarco spirally corrugated tube, it is stated, will withstand pressures in excess of 3,000 lbs. per square inch.

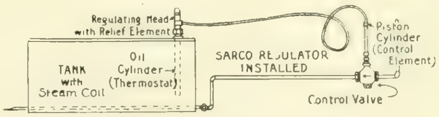


While the regulating system as so far described is complete and would be commercially operative, it is naturally desirable to add some means of adjusting the temperature setting. This is accomplished by having the connection tube issue from the side of the oil cylinder instead of from the top, and then inserting from above a piston which can be adjusted up or down by a regulating screw. When adjusted downward the temperature in the tank need evidently rise less before pressure is transmitted through the connection tube to close the supply valve, and if adjusted upward the temperature must rise higher before closing will take place. The construction is shown in the illustration below. It will be seen that Sarco spirally corrugated tubing is again brought into service to provide a pressure-proof packless flexible fit.


Oil Cylinder with Adjustment Device
Connection Tube
TANK
Cylinder with Packless Piston
Supply Valve
Gas Flame
Gas Line

The Sarco regulator is also equipped with a relief element which will yield if the pressure after the control valve has been closed should for some special reason continue to rise and exceed even the high limit of strength of the Sarco tubing. That element is a special heavy spring interposed between the manually adjustable head of the rod in the oil cylinder and the piston which the rod pushes. The spring strength is such that it will yield when pressure is too high, restoring itself to normal length when normal conditions are resumed.

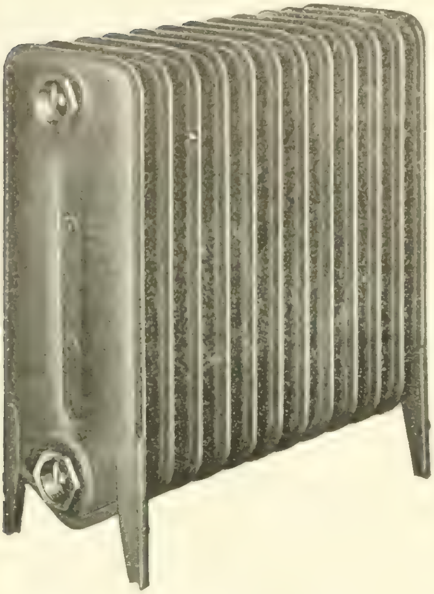
The Sarco temperature regulator operates gas, steam or water valves and can be used for tank or atmospheric control.


Regulating Head with Relief Element
TANK with Steam Coil
Oil Cylinder (Thermostat)
SARCO REGULATOR INSTALLED
Piston Cylinder (Control Element)
Control Valve

SARCO SYSTEM COMPLETE.

Not Needed with the Webster System of Steam Heating is the title of a circular giving the comment of Warren Webster & Co., Camden, N. J., on the notice contained on a tag found in a hotel room. The notice read, "In operating the radiator, please open the valve as far as it will go. To shut off heat, close valve tight. Do not open valve a little, thinking you will get a small quantity of heat, as the pipes will make a noise and fill with water, which will run out, ruining carpet and walls below." These precautions are not needed with the Webster system of steam heating, it is pointed out, as no air valves are used and control is had of each radiator by one valve. Turning it off or on, as much as desired, will result in modulation of temperature. A partial list is added of the 400 hotels heated by the Webster system.

Walker Wrought-Iron Radiator, manufactured by the Kansas City Radiator Co., Kansas City, Mo., is an interesting product which has recently been placed on the market and which is illustrated and described in a catalogue issued by the company. The Walker radiator is designed for use with steam, hot water, vapor and vacuum systems, and is the invention of Thomas H. Walker. Among the



WALKER SECTIONAL AND INTERCHANGEABLE RADIATOR

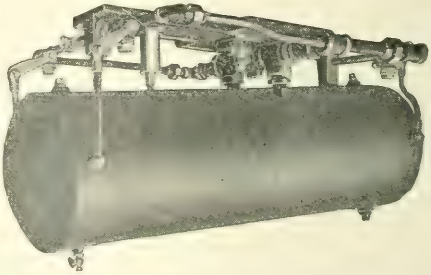
advantages gained by the new construction are the diminishing of the floor space occupied by the radiator nearly one-third, as compared with a cast-iron radiator; the neat appearance of the new type, and the increase in heating efficiency, without sacrifice of strength or durability. The radiator is made of wrought-iron, combined with a copper alloy to make it non-corrosive and rust-resisting. It is sectional and interchangeable, being made without end or leg sections. The legs, which are separate pieces, are also adjustable to variations in height from the floor. An ingenious interlocking device is used in the construction which, it is stated, enables the radiator to withstand high pressures and rough usage. It also eliminates the punching of holes and the use of rivets.

Organization of the Farnsworth Company.

Following the retirement from business of the Farnsworth Mfg. Co., of Boston and New York, F. C. Farnsworth, who was prominently identified with the former company, has organized the Farnsworth Company, with general offices and plant at Conshohocken, Pa. Mr. Farnsworth, in describing the new line of steam utilities being manufactured at Conshohocken, states that he has re-designed and rebuilt an entirely new line of steam traps, both as regards principle and operation, capable of handling condensation under any condition. The tanks, all valves, fittings and connections are extra-heavy and tested to 400 lbs. pressure. Each tank is carried on a steel shaft with a Babbitt metal bearing to reduce friction. There is no load on the trunnions which consist of the Tuxedo swing joint. The valve is a straight-through blow valve, extra heavy, and all apparatus carrying a pressure of 100 lbs. or more is equipped with Monel metal seat and disc valves.

Oil-cushion dash-pots are used on all of the larger machines to relieve any jar or shock in the oscillation, while graphite lubricator cups are supplied with all machines to keep the valves and swing joints well lubricated.

Extra heavy material is also used in the construction of the company's line of duplex boiler feeders. The tank of the boiler feeder is of electric-weld construction and is tested to 500 lbs. hydrostatic pressure before being sent out. All connections into the tank are also welded. Each machine is equipped with oil dash pots to relieve all possible shock or jar in the operation of the tanks. This boiler feeder, it is stated, is particularly well adapted for feeding high-temperature condensation direct into the boilers. It acts in the capacity of a receiving tank, boiler feed pump and pump governor, as it automatically receives the discharging water from all steam traps, dry kilns, heating system lines, etc., and feeds it direct into the boiler. With its duplex or double-compartment tank construction provides a continuous process of receiving condensation and delivering it into the boilers.



FARNSWORTH VARIABLE PRESSURE TRAP FOR DRAINING APPARATUS IN WHICH THE PRESSURE CHANGES FROM HIGH TO LOW.

The company's complete line includes tilting steam traps, automatic duplex boiler feeders, together with return, separating or non-return, lifting, vacuum, condenser and variable pressure traps.

Carrier Psychrometric Chart.

A distinct service has been rendered to the heating and ventilating trade by the Carrier Engineering Corporation, New York, in sending out a well-mounted and framed psychrometric chart, accurately drawn and ready for use. The chart measures 17 in. x 11 in. and is mounted on metal, adding much to its durability.

UNDERWRITERS' RULES.

The National Board of Fire Underwriters has adopted certain rules and regulations governing heating and ventilating systems. The regulations are divided into three main divisions: (1) Fans, (2) Ducts and Flues, and (3) Kitchen and Cooking Vents. These rules are as follows:

BLOWERS. The word blowers is used to include blowers and fans.

(*a*) Blowers shall be so located as to be accessible for repairing and lubricating.

(*b*) Casings to be strongly built and properly reinforced where necessary; joints shall be air-tight. Casings and runners shall be entirely non-combustible, and large enough not to require overspeeding. To prevent accidents openings into casings shall be protected with substantial screens or their equivalent.

(*c*) Bearings and journals to be constructed in accordance with the best modern machine design and so proportioned as to prevent overheating. The bearings shall be self-oiled and so designed as to prevent leakage of oil. They shall be located outside of casings or ducts wherever possible. If located inside of casings or ducts, oilless self-lubricating bearings shall be used, made of bronze bushings fitted with plugs, such as graphite or metaline.

DUCTS. The word ducts is used to include ducts, flues, pipes and tubes.

(*a*) Openings through floors for the circulation of air from one story to another shall not be used.

(*b*) Entire system of ducts to be self-contained; no rooms, hallways, attics, hollow spaces, voids, nor other portions of the building shall be used for air chambers or ducts, unless of fire-

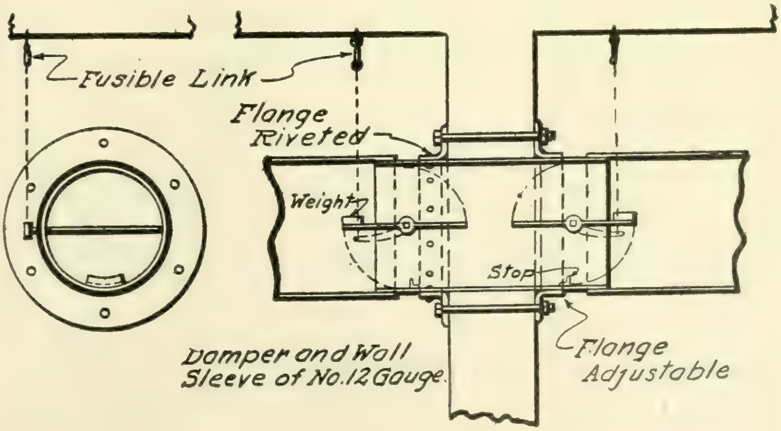


FIG. 1.

resisting construction, and then only by permission of the inspection department having jurisdiction.

(*c*) Ducts shall be made of galvanized iron or other approved non-combustible material. The same applies to enclosures of steam coils used for heating air.

(*d*) To be thoroughly braced.

(*e*) To be substantially supported by metal hangers, brackets or their equivalent.

(*f*) Where subject to mechanical injury, ducts to be properly protected.

(*g*) In no case shall the clearance between any metal ducts and combustible material be less than 1 in.

(*h*) The passing of ducts through fire walls should be avoided wherever possible. Where ducts pass through fire walls they shall be provided with automatic dampers, or national standard vertical automatic fire doors, located on each side of the wall through which they pass. (See Fig. 1.)

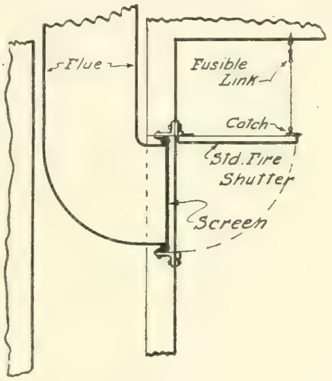


FIG. 2.

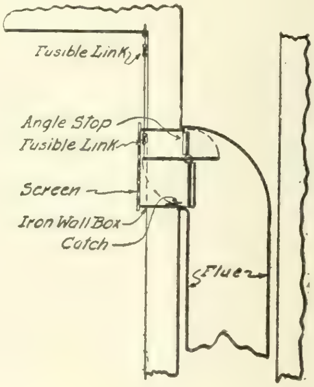


FIG. 3.

(*i*) All ducts passing through floors shall be made of, or protected throughout by, approved fire-resisting materials, such as 4 in. brick, hollow tile, or 2 in. cement-plastered partition, supported by a substantial steel frame.

(*j*) Where vertical ducts serve more than one floor, automatic dampers shall be provided on all outlet openings directly from such vertical ducts, and at all connections with branch ducts from such vertical ducts. (See Figs. 2 and 3.)

(*k*) Joints between ducts and floors, walls or partitions, must be made tight by non-combustible materials.

(*l*) Outlets on supply and exhaust ducts should always be protected by means of register faces or wire screens.

(*m*) Intake of air to be from outside except in re-circulating systems, and shall be taken only from areas containing non-combustible material. Intakes must be protected with rolling shutters or heavy doors.

Intake and intake rooms, steam coils and blowers, etc. shall be segregated in a room cut off by fire-resisting partitions from other portions of the building.

(*n*) Blower systems should preferably have an emergency or automatic control to shut them down in case of fire. This may be done automatically by means of devices utilizing fusible links, thermostats, or automatic sprinklers. Such installations to be subject to the approval of the inspection department having jurisdiction.

COOKING APPLIANCES.

(*a*) Ventilating ducts used to carry off the grease-laden vapors from hoods over cooking appliances, especially in kitchens of large restaurants and hotels, shall be constructed similarly to boiler smoke flues, and, if of metal, must be of not less than No. 16 U. S. gauge, so substantially built that the grease and gum could be removed from the interior by burning out under a flash fire.

(*b*) The ventilating ducts shall be an independent system in no manner connected with other house ventilating systems.

(*c*) Ducts should not be connected to stacks, chimneys or flues used for other purposes.

(*d*) A live steam jet should preferably be provided at the end of the duct nearest the cooking appliances.

VELOCITIES RECOMMENDED FOR HEATING AND VENTILATING SYSTEMS IN SCHOOLS, PUBLIC BUILDINGS, CHURCHES, ETC.

Supply Air.

	Velocity Through Free Area.
Cold air intake	700 to 1000 f.p.m.
Cloth filter	about 40 “
Air washer	500 “
Heaters	800 to 1200 “
Horizontal ducts	1200 to 1400 at fan decreasing to 600 f.p.m. at base of vertical flues.
Vertical flues	400 f.p.m. for masonry flues. 500 f.p.m. for galv. iron flues.
Register outlet (free area)	200 to 250 f.p.m.
Grilles (total area)	“ “ “ “

Air outlets 15 ft. or more above the floor may be run up as high as 350 f.p.m. if not thrown directly down on persons below.

Exhaust Air.

	Velocity Through Free Area.
Registers or total area of grilles	300 to 400 f.p.m.
Vertical flues	400 f.p.m. for masonry flues 500 f.p.m. for galv. iron flues.
Horizontal ducts	600 f.p.m. at far end up to 1200 or 1400 f.p.m. at fan inlet.
Discharge openings	700 to 1000 f.p.m.

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Magazine

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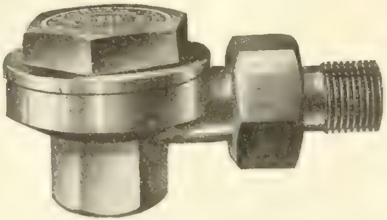

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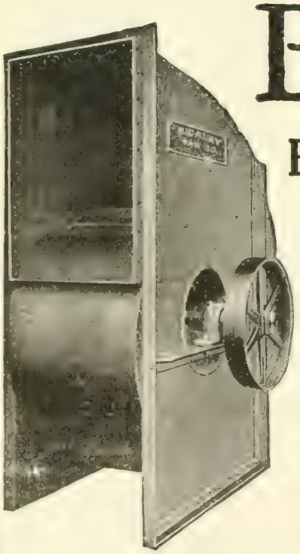

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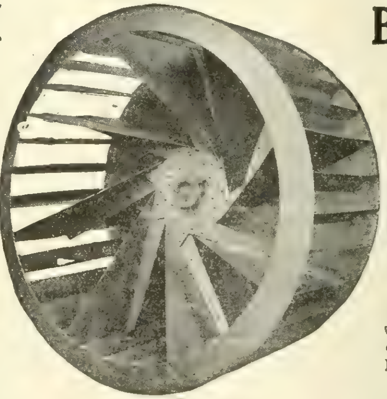

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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. SEPTEMBER, 1917 1123 Broadway, New York

Operation of Large Federal Buildings in Washington

With Detailed Data for the District Building, Washington Post-Office and the National Museum Group.

By NELSON S. THOMPSON.

Presented at the recent annual convention of the National District Heating Association.

It is regretted that existing conditions render it undesirable for the writer to give the full engineering data in connection with the Central Heating, Lighting and Power Plant designed to serve twenty-one of the most important Federal buildings in the City of Washington, D. C. At a later date it is hoped that the full and complete data may be submitted to the Association for criticism.

At this time I can only describe an interesting part of the problem in designing this plant—that of determining the operating characteristics of the completed and occupied buildings, and predicting the operating characteristics of the buildings under construction, in line with the writer's practice for Federal buildings.

The estimated amounts of steam used by the occupied buildings were determined from the amount of coal used in each building on the basis of an evaporation of 8.62 lbs. of water per pound of bituminous coal, or 6.38 lbs. of water per pound of anthracite coal (mostly pea coal). These evaporation figures were obtained as the result of trials on a given set of boilers, extending over a period of two weeks, one on a set of boilers equipped for burning anthracite, and one on a set of boilers equipped for burning bituminous coal.

Car-mile recorders were used on the elevators, and revolution counters on the elevator pumps.

The amount of electric current was readily obtainable in each case from the building records.

ESTIMATING THE OPERATING CHARACTERISTICS.

The operating characteristics of the uncompleted buildings were estimated, in accordance with the practice of the writer, as follows:

The total cubic contents of the average Federal building multiplied by four is assumed to equal the total pounds of steam per annum for heating and ventilating the building.

The average demand for steam per hour for heating and ventilating equals the annual consumption divided by 5,000.

The maximum demand for steam per hour for heating and ventilating is 2½ times the average demand.

If the heating surface is known, the

blast coils are reduced to equivalent direct radiation by multiplying the square feet of heating surface in blast coils by 3; and after all surface is reduced to equivalent direct steam radiation, to ascertain the total steam required per annum, the number of square feet equivalent direct steam radiation is multiplied by 500. This is used as a check on the first assumption, and the mean of the two quantities is generally taken.

Gravity indirect water or steam radiation is reduced to equivalent direct water or steam radiation, as the case may be, by multiplying by 1½.

To reduce direct hot water to direct steam equivalent, it is divided by 1.6.

Car miles per day for each elevator in an ordinary small Federal building are taken at 5; while in the large buildings of six or eight stories, in places like New York and Philadelphia, and in the Departments at Washington, each passenger elevator will average 10 car miles per day.

Kilowatt-hours per car mile for electric elevators equal 5.

Steam per car mile for hydraulic elevators operated by compound duplex steam pumps equals 1,000 lbs., while for high-duty pumps it amounts to 650 lbs.

Steam per annum used for heating water for sanitary purposes is 10% of the total steam used for heating and ventilating the building.

For a post-office building (a 24-hour activity), the annual current consumption in a modern large Federal building will average 2½ kw-hr. per square foot of total floor area; while in a large modern Federal building of eight-hour activity it will average 1¼ kw-hr. per square foot.

In Federal buildings of 1,000,000 ft. cubic contents or smaller, with 24-hour service and electric elevators, the current consumption per annum will average 0.8 kw-hr. per square foot total floor area.

The average demand for electric power and light will be the total annual consumption divided by 8,760, and the maximum demand will be 2½ times the average demand in a 24-hour building, and 4 times the average in an 8-hour building.

If an electric generating plant is installed in a building, using high-grade 4-valve engines, 50 lbs. of steam is allowed for each kw-hr. generated, on the switch-board, with no allowance for the exhaust into the heating system. This is done to cover fully all the losses which are incident to a modern small plant.

To reduce the pounds of steam to coal, as previously indicated (covering all losses in the plant), an average evaporation of 8 to 1 is assumed for bituminous coal, and 6 to 1 for anthracite pea or buckwheat coal.

Boiler room repairs, $1 per h.p. of nominal boiler h.p. rating.

Engine room repairs, $1 per kw. of nominal total kw. rating of generators.

Boiler and engine room supplies, $2 per kw. of rating of generators installed with a generating plant.

Boiler room labor averages $2 per ton of coal fired, which is based on 8-hour shifts and an average wage per day of $2.50 for each fireman. In the smallest generating plants one chief engineer at $1,400 and three assistant engineers at $1,200 each per annum must be provided, and in the larger plants the salaries are increased and additional labor supplied.

The labor in a Federal building containing an electric generating plant will roughly average the same as the cost of the coal, supplies and repairs to the boilers and electric generating plant.

The fixed charges are those sanctioned by the Bureau of Standards for machinery in Federal buildings; *i .e.,* 3% interest and 5% depreciation per annum on engines, boilers, etc.; while on buildings, tunnels, seawalls, cables, etc., 2% depreciation per annum is allowed.

The annual dividend which must be earned by the ordinary isolated plant in comparison with the purchase of current from a public utility is 6% on the cost of the Government plant.

STEAM CONSUMPTION FOR HEATING IN EIGHTEEN LARGE BUILDINGS.

From the records of eighteen large buildings scattered over the entire United States, it is found that the average of the steam consumption per month for heating is as follows:

October	6%
November	11%
December	18%
January	18%
February	18%
March	15%
April	10%
May	4%
	100%

The application of the foregoing data to a few of the buildings to be served by the Central Heating, Lighting and Power Plant, and to one where steam and electricity are now purchased, will show that the approximations noted are fairly accurate:

DISTRICT BUILDING, WASHINGTON, D. C.

Contents, 4,600,000 cu. ft.

A small portion of the building is used 24 hours a day for police headquarters.

Building is equipped with electric generators, and all fans, etc., are electrically operated.

Kw-hr. generated per annum in the isolated electric plant, 436,000.

Total square feet floor area, 325,000.

4,600,000 multiplied by 4 equals 18,400,000 lbs. steam for heating and ventilating on cubic contents basis.

40,000 multiplied by 500 equals 20,000,000 lbs. steam for heating and ventilation on equivalent direct steam radiation basis.

Average of the two foregoing items equals 19,200,000 lbs. steam for heating and ventilating.

436,000 multiplied by 50 equals 21,800,000 lbs. steam used to generate electricity.

Steam for heating water for sanitary purposes is 10% of 19,200,000, or 1,920,000 lbs.

Total steam for all purposes, 42,920,000 lbs.

The survey shows 38,617,000 lbs. based on coal actually burned, using the evaporation factor of 8 to 1.

Maximum demand for steam for heating 21,120,000 divided by 5,000 multiplied by 2½, equals 10,000 lbs.

Maximum demand for electricity, 436,000 divided by 8,760, multiplied by 4, equals 200 kw.

200 kw. multiplied by 50 equals 10,000 lbs. steam, less 20% for condensation, or 8,000 lbs. available for heating, so that the boiler must generate 2,000 lbs. more to heat the building, or 12,000 lbs. per hour for electricity and heating.

12,000 divided by 30 equals 400 h.p. maximum demand on boilers, which is close to the rule of Arthur Williams, of the New York Edison Company, of 1 boiler h.p. per 10,000 cu. ft. of building.

Total coal burned (bituminous), 42,920,000 divided by 8, multiplied by 2,240, equals 2,400 long tons.

The coal actually burned was 2,010 long tons.

Total floor area, 325,000 multiplied by 1¼, equals 406,000 kw-hr.

Average demand, 406,000 divided by 8,760, equals 46 kw.

Maximum demand, 46 multiplied by 4, equals 184 kw.

There was actually used in the building 436,000 kw-hr. per annum.

The measured average demand was 50 kw.

The measured maximum demand was 222 kw., with a maximum surge of 300 kw. due to electric elevators.

WASHINGTON (D. C.) POST OFFICE (NEW).

(Not in the Central Power Plant group, but is served with steam and electricity from the Government Printing Office, about 600 ft. distant.)

Total square feet floor area, 327,000.

Contents, 5,860,000 cu. ft.

Square feet direct steam radiation 27,000.

Steam and electricity supplied from the Government Printing Office.

Square feet in cooling coils used to cool condensation before discharging same to sewer, located under preheating coils, 2,500.

Square feet of steam blast coils, "Vento," 11,000.

Cubic feet in building per square foot steam radiation of all kinds, 150.

Cubic feet in building per square foot equivalent direct steam radiation, on basis of blast coils multiplied by 3 equals direct radiation, and without cooling coils, 98.

All elevators and other machinery are electrically operated.

Equivalent direct steam radiation, 60,000 multiplied by 500 (pounds per square foot per season) equals 30,000,000 lbs. steam per annum, plus 10% for heating water for sanitary purposes, equals 32,000,000 lbs.

The average demand would be 33,000,000 divided by 5,000, or 6,600 lbs. per hour.

The maximum demand would be 6,600 multiplied by 2½ equals 16,500 lbs., or 550 boiler h.p., or 1 to 10,000 cu. ft. of contents.

Using the rule for cubic contents only, the steam used per annum would be 5,860,000 multiplied by 4 equals 23,440,000, plus 10% for water heating, equals 25,784,000 lbs.

Average demand would be 25,784,000 divided by 5,000, or 5,100 lbs.

Maximum demand would be 5,100 multiplied by 2½, or 12,800 lbs.

12,800 lbs. per hour equals 430 boiler h.p.

The actual maximum measured demand for steam was 11,000 lbs. per hour in January.

The actual steam-flow meter readings were as follows:

Total annual consumption of steam, 33,580,000 lbs.

Average demand, 6,700 lbs.

Maximum demand (in 1915 and 1916), 11,000 lbs.

Boiler h.p. (maximum), 367.

Floor area in square feet, 327,000 multiplied by 2½ equals 817,500 kw-hr. per annum.

Average demand, 817,500 divided by 8,760, equals 92 kw.

Maximum demand, 92 multiplied by 2½, equals 220 kw.

The meter readings show 946,613 kw-hr. actually consumed in 1916; average, 108 kw.; maximum, 288 kw.

The building has a full connected load of 2 watts per square foot floor area, and uses the full connected load, 1,500 hours during the year, and the maximum demand 3,300 hours.

The maximum demand is 44% of the full connected load, which is unusually high, due to a large amount of machinery being used in this building.

NATIONAL MUSEUM GROUP.

(Consisting of the new and old National Museum buildings, and the Smithsonian Institution building, all of which are now served from a central plant in New National Museum.)

Total contents, 16,000,000 cu. ft.

Total floor area, 570,000 sq. ft.

Total equivalent direct steam radiation, 72,500 sq. ft.

Ratio of direct steam radiation to cubic contents, approximately 450 to 1, which is very high, but not unusual with the type of building under consideration.

All elevators are electrically operated.

Total steam per annum, by the rule, would be 16,000,000 multiplied by 4, equals 64,000,000 lbs., for heating and ventilating, plus 10% for water heating for sanitary purposes, equals 70,400,000 lbs., which is away out of line on monumental buildings of this class, and will not be considered.

Total steam per annum by the radiation basis would be 72,500 multiplied by 500, equals 36,250,000 lbs. per annum, plus 10% for heating water for sanitary purposes, equals approximately 40,000,000 lbs.

The electric generating plant produces

400,000 kw-hr. per annum, which, multiplied by 50, equals 20,000,000 lbs. of steam for this service.

Total steam generated, 60,000,000 lbs.

The maximum demand for steam heating and ventilating equals 40,000,000 divided by 5,000 multiplied by 2½, or 20,000 lbs.

The maximum demand for steam for electric generating would be 400,000 divided by 8,760, multiplied by 4, multiplied by 50, equals 9,200 lbs. per hour.

The amount of exhaust steam losses in going to the heat apparatus is 20% of 9,200, or approximately 1,800 lbs.; so that the actual maximum demand on the boilers is 21,800, and the horsepower is 700, which upsets the ordinary rules of Arthur Williams and others when applied to buildings of this peculiar character.

The survey showed that there was actually burned per annum 3,000 long tons of bituminous coal, which, at an evaporation of 8 to 1, equals 53,760,000 lbs. of steam per annum.

The maximum hourly amount of coal burned was 2,240 lbs., which equals 17,920 lbs. of steam, and the reading on the steam-flow meter was 22,500 lbs.

The ratio of total floor area to kw-hr. generated per annum is very low, as might be expected; *i.e.*, 570,000 sq. ft. to 400,000 kw-hr., or approximately .7 kw-hr. per square foot of floor area.

The survey showed a maximum demand of 300 kw., which is out of line with the rule, 400,000 divided by 8,760 multiplied by 4, or 184 kw., due to the fact that practically the entire connected load of the largest building is used at certain intervals during lectures, etc.

The smaller buildings in the group follow the writer's approximation very closely, as they fall into the typical office-building class.

The Heating and Power Plant of a Modern Industrial Building

Features of Equipment in Factory of Phœnix-Hermetic Co., Brooklyn, N. Y.

By H. S.

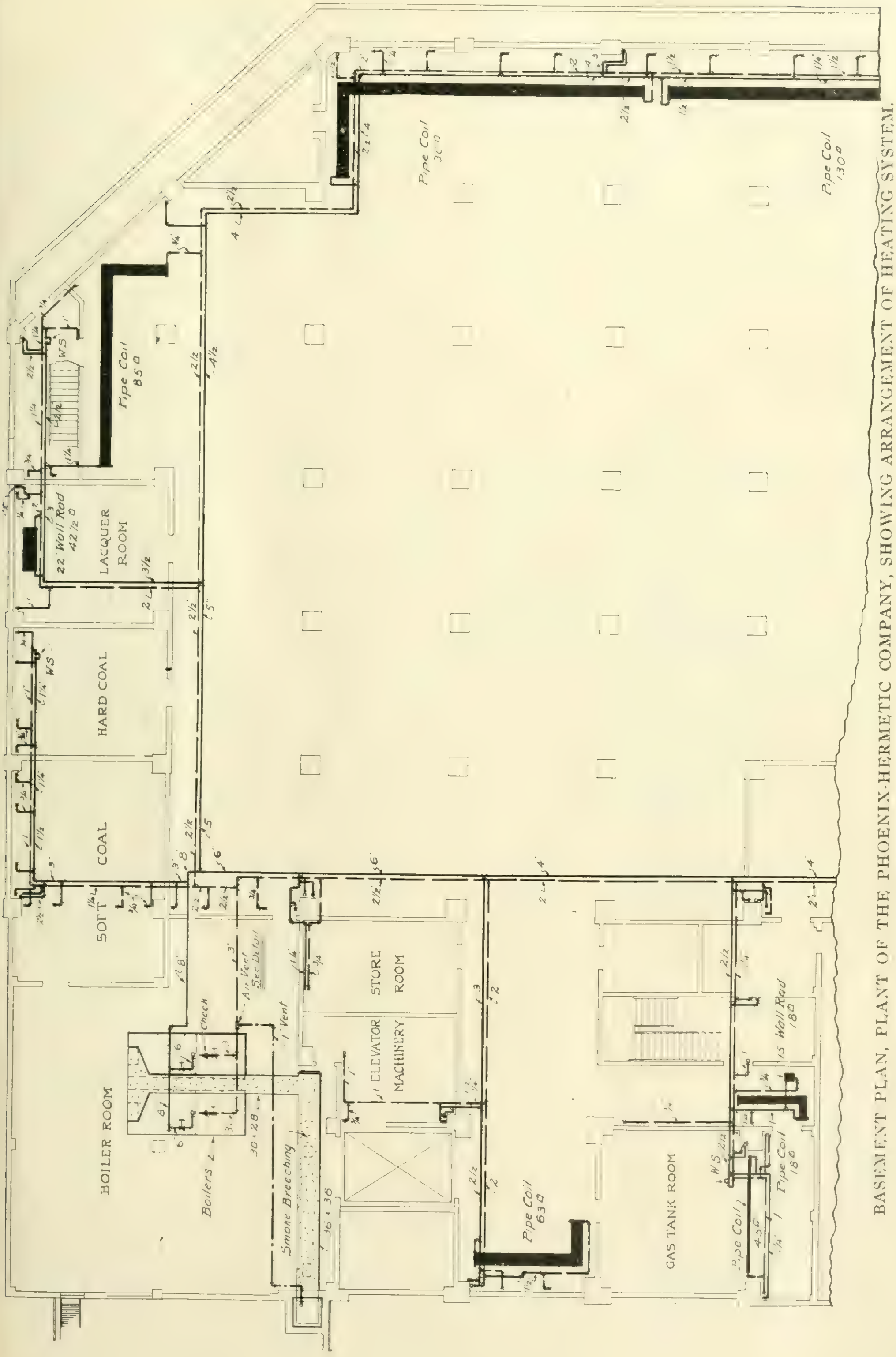
The heating system and power plant of the Phœnix-Hermetic Co. at Thirty-eighth Street and Fourteenth Ave., Brooklyn, N. Y., have many features which differ greatly from most buildings of this type. Gas, generated in the basement by means of a gas producer, is used to run a 100 h.p. gas engine and is also used in high-temperature ovens on the top floor to produce heat for baking japanned products. All the water for the building is supplied by pumps from a well, sunk in the boiler room. Down-draft smokeless boilers are used to generate steam for the heating system, while a small, vertical, high-pressure boiler supplies steam to the producer. This building is four stories high with basement, and is built of reinforced concrete. It is exposed on all four sides. The building was designed by H. Atterbury Smith and William P. Miller, architects.

GAS POWER USED TO GENERATE ELECTRICITY.

The electrical power for the building is supplied by a 100 h.p. vertical, four-cylinder, four-cycle Foos gas engine, direct-connected to a Sprague electric generator. This is located in the generator room. A small air compressor, belt-driven by a 4 h.p. Foos gasoline engine furnishes the compressed air for starting the large gas engine. This type of generating unit was selected because it had been used in the Chicago plant of this firm for a great many years and had been found to be highly efficient, particularly on account of the fact that a large quantity of gas is used by this concern in drying and baking ovens. Consequently the gas for use in the engine can be made at a cheap rate. In the gas tank room is located the gas producer for supplying the gas for the engine and for manufacturing purposes. This producer was manufactured and installed by the Flinn & Dreffein Co., Chicago. It is about 12 ft. high and 7 ft. 6 in. in diameter. After the gas is manufactured in the producer (in which pea coal is used for fuel) it passes by natural circulation into the equalizer, where the proper amount of air is automatically mixed with the gas. From there the gas passes into the scrubber, which is a large tank with layers of coke over which the gas passes to be cleaned. Water flowing over trays through which the gas must pass serves to clean it and also to cool it. It finally passes through a layer of excelsior in the top of the scrubber, which is the last cleaning process.

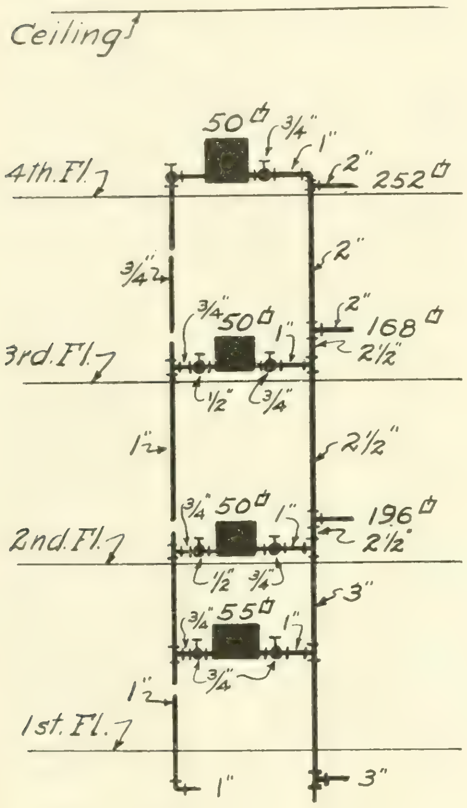
The 8-in. pipe supplying the gas for the engine is taken directly from the top of the scrubber, the flow being accelerated by the suction in the engine cylinders. A 4-in. line is also taken from the top of the scrubber to supply the high-temperature dry rooms, located on the top floor. This 4-in. line runs to a Sturtevant blower which blows the gas through the 4-in. line to the top floor by producing pressure on the gas line of 1.1 to 1.6 lbs. per square inch. A re-

PLANT OF THE PHOENIX-HERMETIC COMPANY, BROOKLYN, N. Y.



BASEMENT PLAN, PLANT OF THE PHOENIX-HERMETIC COMPANY, SHOWING ARRANGEMENT OF HEATING SYSTEM.

circulating connection is made around the blower by means of a back-pressure valve, so that, when the demand is light in the ovens, causing a pressure to be built up in this line and lifting the back-pressure valve, some of the gas will be recirculated instead being all taken from the scrubber. A ¾-in. steam jet from the high-pressure boiler is connected to the pipe from the producer to the equalizer and accelerates the draft in the producer. There is also an 1¼-in. steam connection to the 6-in. line running to the roof from the equalizer which is used when starting up to increase the draft in the producer.



TYPICAL RISERS AND CONNECTIONS.

All the water for the building is supplied by a 6 × 8-in. motor-driven Deane pump, being taken directly from a well sunk in the boiler room to a depth of 160 ft. The water is pumped to a house tank located in the tank room on the roof of the building and is distributed through the building from that point.

SELECTION OF HEATING SYSTEM.

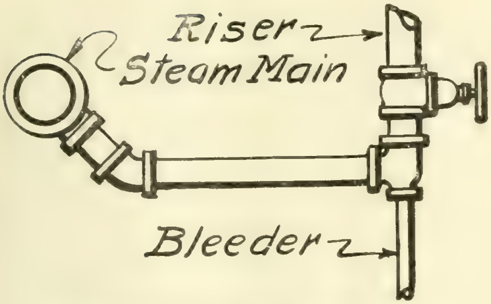
The heating system is a Positive air return system and was installed by the H. P. Stephenson Co., contractors. By venting all the air from the system in the basement, all air valves were eliminated from the radiators and coils. An automatic valve was placed at the return end of each radiator and coil, instead of the ordinary hand valve, so that it is only necessary to operate the supply valve when shutting off a radiator or coil.

Two Oil City down-draft boilers, 90 h.p. each, supply the steam for the heating system. Boilers of this type were selected from a commercial standpoint. By burning soft coal considerable saving is effected in the operation cost of the plant. In order to comply with the smoke ordinance, boilers of the down-draft type had to be used. A 30 in. × 30 in. breeching of No. 10 black iron from each boiler is connected to a 36 in. × 36 in. flue, with provision made for a future boiler should the plant be extended. The brick stack is 36 in. × 36 in. and is about 80 ft. high.

THE PIPE RUNS.

A 6-in. steam outlet from each boiler runs into an 8 in. supply header near the ceiling of the boiler room and thence out into the basement storage space. It then divides into two mains, one 6 in. and one 5 in., running in opposite directions around the building, decreasing as risers and first floor radiator connections are taken off. These mains have a slight grade in the direction of flow. The riser connections are taken from the bottom of the steam main and the base of each supply riser is dripped through an impulse valve into the dry return main.

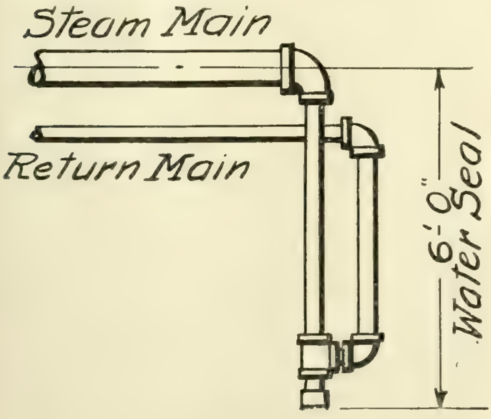
The first floor radiator connections are taken from the top of the steam main and grade back to the main. The end



DETAIL OF TYPICAL STEAM RISER CONNECTION.

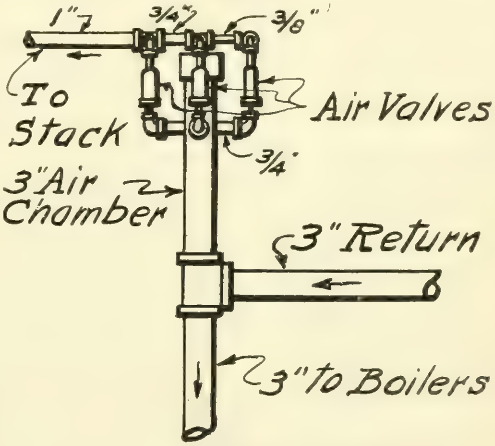
of each main is dripped through a loop seal of 1-in. pipe six feet deep, connecting back to the dry return main. Starting with 1¼ in. at these points two dry return mains are run underneath the steam mains, graded in direction of flow, increasing in size as radiation is added to them. Just before entering the boiler room the two-2½-in. mains are run into a 3-in. dry return main, and then back to the boilers.

Alongside the boilers, where the lowest point of the dry return is about 24 in. above the water line, a 3-in. all around tee is placed, looking up. This tee has a 3-in. capped nipple 12 in. long, with four-¾-in. tappings on the sides near the top. A thermo-float air valve is connected to each one of these outlets by means of a ¾-in. nipple and elbow. These serve to vent all the air from the system as no air valves are placed on the radiators or coils. From the outlets of these four valves, a 1-in. air line is run to the stack, connecting into the base of same. At the point on the return where these valves are placed the return drops to the floor and divides into a 3-in. connection to each boiler. Close to each boiler on the return is placed a check valve, a gate valve and a 2 in. blow-off cock.



DETAIL OF SEAL AT END OF STEAM MAINS.

The smoke flue in boiler room is covered with 1½-in. asbestos air cell blocks, put on over a 1-in. air space formed of wire mesh and studs, the whole being finished smooth with asbestos cement. The steam mains are covered with 85% magnesia covering 1 in thick, canvassed and banded, and the fittings covered with asbestos cement. All return mains are uncovered, serving as additional heating surface for the basement.



DETAIL SHOWING ARRANGEMENT OF AIR VENT.

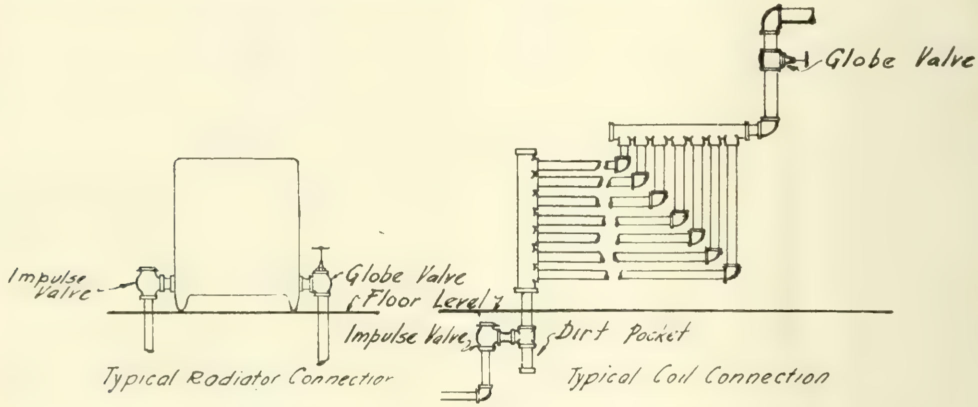
HEATING OF FACTORY ROOMS.

The heating of the factory rooms in general is accomplished by means of wrought-iron pipe coils of the header type, with spring pieces. They are fastened to the walls with cast-iron hook plates and wrought-iron cleats. These cleats are of ⅜-in. by 2½-in. strap iron, and are held to the wall by expansion bolts. Overhead coils are supported by roller hangers, fastened to the ceiling.

Cast-iron radiators are used in the offices, halls and part of the first floor loft, where coils are not adaptable. The supply end of each radiator and coil is equipped with a Jenkins Bros. globe valve and the return end has an impulse valve as stated, of proper size. These serve to establish and maintain a standard difference in pressure between the steam and return mains, passing the air, water and a small percentage of steam into the return pipe.

DOMESTIC HOT WATER SUPPLY.

A No. 7 Patterson hot water tank, at the boiler room ceiling, is used during the heating season for heating the hot water for domestic purposes. A 2½-in. steam line is run from the main header of the boilers to the coil in the tank and a 1½-in. return connection is run to the wet return on the boiler room floor from same. Powers thermostatic valves are placed on both the supply and return from the tank. A thermostat is tapped into the shell of the tank and the tube from same is run to the thermostatic inlet valve. A 2-in. cold water supply line is run to the tank and a 3-in. outlet supplies the hot water for the building. The entire tank is covered with 1½-in. asbestos air cell blocks wired on and finished with a hard, smooth coat of asbestos cement. A No. 182 Ideal Premier hot water tank heater is connected with the Patterson hot water tank and is used in summer for heating the water. However, the tank is valved so that either method may be used to heat the water at any time.



TYPICAL RADIATOR AND COIL CONNECTIONS.

A 5 h.p. Beggs vertical high-pressure boiler in the boiler room is used for supplying steam to the gas producer. A pressure of 40 lbs. is carried on this boiler, but the heating boilers are usually operated at a pressure less than 2 lbs. per square inch.

ELECTRIC CURRENT PRODUCED AT 3 1-5 CENTS PER K. W.-HR.

The total daily electrical load comprising the motor and light load is 360 K. W. hours. This current is produced at a cost of 3 1-5 cents per K. W. hour, due to the low cost of generating gas. The total amount of gas generated daily is 63,000 cu. ft., of which amount 11,000 cu. ft. is used in the engine and 52,000 cu. ft. is used for manufacturing purposes. The cost per 1,000 cu. ft. of generating this gas is 38 cents, which is a very cheap rate, although the gas is not as rich as that supplied by the public service company.

The heating season is from October 15 to April 15. During the season of 1915-16, 489 tons of 2,240 lbs. each of coal were used for heating, but during the past season 1916-17, only 441 tons were used. The coal used was mine-run bituminous coal, which can always be bought comparatively cheap. The discrepancy in the amount of coal used for two seasons was due to the fact that until last season the down-draft boilers were not fired and taken care of properly. Having a total of 7,005 sq. ft. of heating surface, there was 170 lbs. of coal used, per square foot of radiation for the last heating season. The total volume of the building is 1,200,000 cu. ft. Therefore, 0.62 lbs. of coal were used per cubic foot of contents, which is a very reasonable figure.

Dehydrating Fruits and Vegetables

By FRED R. STILL

(Read at the summer meeting of The American Society of Heating and Ventilating Engineers, in Chicago, July 18-20, 1917.)

It has been variously estimated that from 10% to 20% of the vegetables and fruits raised in this country are wasted because they are unfit for consumption by the time they are marketed and considerably more is greatly depreciated in value owing to deterioration. With all the amateur farmers engaged in raising crops this year, the proportionate loss will be more, unless decay can be avoided by dehydrating the product, but how to dehydrate it is the point we are interested in. It will not be attempted herein to tell you how is the *best way* to go about it, as *that* way has never been discovered. An attempt will only be made to indicate what may be done, how it can be done and how some have already done it.

Everybody knows from study or by experience that the simplest drying problem is usually quite complex, but where it involves dealing with substances which contain from 72% to 95% water which must be extracted without injury to the food value, flavor, odor, color or chemical composition, and this at the same time without a large investment or adding so much to the cost as to make the product unsalable at usual market prices, then it will be agreed that it is superlatively complex as an engineering problem.

DIFFERENCE BETWEEN DEHYDRATING AND DRYING.

It is the accomplishment of these essential elements, so necessary in preserving foods, that distinguishes "dehydration" from ordinary "drying," as the latter is commonly understood. "Dehydration" is accomplished by the evaporation of moisture at comparatively low temperatures, whereas "drying" is usually accomplished by applying as much heat to the material as it will stand so as to vaporize the contained moisture, only employing enough air circulation to carry away the moisture.

A certain concern in this country has done a lot of dehydrating of fruits and vegetables with very favorable results. But so far as can be observed, it is accomplishing nothing but what others have done in specific cases. Credit is due this particular concern though for the laborious effort and expense put into the study of the effect of dehydration on a great variety of substances. This has provided their engineering staff with some very valuable data, whereby they know what are the critical temperatures of many substances and under what conditions the best results are attained most economically.

This method is not patented except as applied to one substance and probably is not otherwise patentable. We discovered an application title that they filed some years ago, which indicates they tried to patent it, but could never get it through the patent office to final issue. They have numerous patents on the dryer and devices in connection therewith, however.

The concern claims to be able to dry 25 tons of sliced apples per day of 24 hours with one of their standard outfits, allowing but 2 hours to dry. This is equivalent to about 2,083 lbs. per hour or 55 bushels of raw apples per hour containing 84.6% of water. When the apples are commercially dry there is still retained from 6% to 12% moisture. In fact, there is not much use trying to remove all the moisture from anything, as most substances will take up 6% to 8% moisture again from the atmosphere before packing in sealed receptacles can be accomplished.

This 84.6% of 2,083 lbs. is 1,763 lbs. of water, hence the absolutely dry fruit weighs only 320 lbs. or 15% of the raw weight, and commercially dry with 12% moisture retained weighs 364 lbs., there being 44 lbs. still retained in the output of the dryer per hour; 1,763 lbs., less 44 lbs. leaves about 1,720 lbs. of water to evaporate per hour.

In two of their patents they claim to have found the best results when raising the temperature about 61° F. above the outside atmosphere, and give as an example 70° outside, plus 61° or 131° inside. We will use these figures in this problem to illustrate some of the physical properties of air, heat, vaporization, cooling and refrigeration, not because we agree with their statements entirely, nor that they are even safe to follow in every case, but because they answer our purpose as well as any others. We would also add that all computations were made on a slide rule, so most of the figures beyond three digits are dropped, but the results are then even closer than should be figured without adding liberal factors of safety for such problems, involving, as they always do, so many indeterminate variables.

FIGURING A TYPICAL DRYING PROBLEM.

Assuming the outside air to be 70° F. and 50% saturated, the dew point is 50°, the wet bulb 58°, and each cubic foot of air contains 4 grains of moisture. Heating this air to 131° F. will raise the wet bulb to 77°. If this air takes up 3 grains of moisture while going through the dryer, it will then carry 7 grains, the dry bulb temperature will be reduced to 104° and the dew point will be 66° F.

Heating 1,720 lbs. of water from 70° to 104° and evaporating it at that temperature, heating 44 lbs. of water and 320 lbs. of substance having a specific heat of 0.50 from 70° to 131° F. and about 1,000 lbs. of conveying apparatus through these latter temperatures, also allowing about 30% to cover the leaks and the radiation from the ducts and dryer building, we find the total heat will amount to about 2,420,000 B.T.U. per hour.

If each pound of air drops from 131° to 104° while passing through the dryer, then it must give up 6.41 B.T.U.; hence dividing the total heat required by the dryer, by the loss per pound of air, gives us 377,500 lbs. of air per hour, or about 6,300 lbs. per minute, which is about 84,000 cu. ft. per minute at 70° F. This air must be raised from 70° to 131°, so the heat put into the air by the heating apparatus will amount to 61° × 0.2375 × 377,500 lbs., or 5,600,000 B.T.U. per hour. Hence the dryer efficiency will thus be about 43.25% on a heat basis.

EVAPORATIVE EFFICIENCY USUALLY ABOUT 50%.

This question of evaporation efficiency brings up a very fine point that often leads to endless discussion. Naturally if the air absorbs more moisture while passing through the dryer, the resultant efficiency will be higher. But in so doing the outgoing temperature of the circulating air becomes lower. In other words, if, in the preceding case, the air had been completely saturated as it left the dryer, then the dry bulb and the wet bulb temperatures would be alike, or at 77°, instead of the dry bulb temperature being 104°. The effect of this would be to very materially slow up the drying process, start fermentation, cause the forming of mildew, discoloration and leave a bitter taste and bad odor with the product.

Just how far to go in saturating air within a dryer is one of the things to be learned by experience with every product you have to deal with. Besides, latitude and altitude have an influence on any dryer and calculations must take them into consideration in extreme cases. A dryer built to certain proportions, which had done splendid work in Florida all the year around, might prove a "bigger frost" in Bismarck, N. D., in the winter time than even the frost in the atmosphere of that noted cold spot. As a general proposition you are "playing safe" on most drying problems if you keep the heating efficiency around 50%. It is only the experienced specialist who gets above that mark and usually then by expert handling after installation.

OPERATING COSTS.

To furnish steam for this dryer would require 168 boiler h.p. Allowing 4 lbs. of coal per h.p. hr., it would require about 672 lbs. per hour, which at $5.00 per ton, would cost about $1.68 per hour, or about 3c per bushel of raw apples for the fuel alone.

To drive the fan would require about 60 h.p., but the exhaust steam from an engine could be used in the heating apparatus, thus making practically no cost for power, beyond lubricating oils, attendance, etc.

Allowing for depreciation, interest, insurance, taxes and repairs for a year, and coal, attendance, oil waste and supplies for 5 months continuous operation of 24 hrs. per day, it will cost about $40.00 per h.p. to run such a plant, or about $6,800.00 per annum. If it turns out 55 bu. per hour every day, including Sundays, for 130 days, the output would amount to 171,600 bushels. Hence the cost of operation would be about 4 cents per bushel.

Even if it cost 5 cents per bushel to dehydrate the apples, it is a good investment. For instance, supposing 10% of the apples would have decayed if they had not been dried, the loss would be 17,160 bushels. If they were worth, say, 50 cents a bushel, the loss would be $8,580. The great advantage, however, is due to the fact that dehydrated food will keep for years. It is not necessary to rush the fruits and vegetables to the market as soon as they are harvested, which naturally "bears" the market price, at the time when the farmer has his only chance to sell. Instead, he can pack his product in comparatively small packages and take his time to dispose of it, when the market conditions are favorable.

Few farmers have enough money on hand, however, to invest as heavily as would be necessary for a plant of this size. The proper thing to do would be to club together on a co-operative basis, or better still, incorporate, install a manager and run it as a community business, just as the beet sugar mills are run, only distributing the stock among the farmers instead of the city capitalists. This would be a much better way to go about it than for each farmer to attempt to buy a small plant for his own use exclusively. He is usually a poor manager of machinery, as well as a poor business manager, hence it would be of greater all-around advantage and profit to him, and to the consumer too, to invest in a corporation and be relieved of the necessity of looking after it. Such a corporation could even build fireproof warehouses to store the product, handle the sales on a commission basis, etc., much the same as the cotton business is handled in certain parts of Texas.

DRYING BY REFRIGERATION EXPENSIVE.

Returning to our problem again to consider another feature which frequently is presented: The question is often asked—"Why not put in a refrigerating plant to condense the moisture out of the air?" Well, the best answer is contained in a few figures, as follows:

The air leaving the dryer is at 104°, containing 7 grains per cu. ft. as 3 grains must be eliminated from each cubic foot; then the dew point must be reduced to 50°. Therefore, the temperature must be lowered 54°.

1 lb. of air containing 31.6% moisture, when lowered from 104° to 40°, will require the absorption of 20.56 B.T.U. Therefore, to take up the heat from 6,300 lbs. of air per minute will amount to 648 tons of refrigeration per 24 hrs.

If the air was cooled to 66° (which is the dew point for 104° dry bulb) by spraying with cold water from a well or spring and then lowering the temperature from 66° to 50° by refrigeration, it will require nearly 200 tons refrigeration. Such a plant would be too expensive and complicated to consider seriously.

Another question which naturally arises, is what will happen when the outside temperature rises to 95° F. and 60% saturation, as sometimes happens in the summer time?

The wet bulb temperature then is 82°, dew point 78°; if raised to 131° the wet bulb is raised to 90°. If 3 grains of moisture are added in the dryer, the dry bulb temperature then drops to 104° again, the air being 60% saturated with a dew point of 86°.

The only practical result would be the consumption of less steam and an increase in the length of time the apples had to remain in the drying chamber, owing to the increased humidity of the air as it left the dryer. This latter could be compensated for by making the dryer large enough to allow, say three hours to dry, instead of two hours.

If a refrigerating plant was to be installed to take care of these latter conditions it would have a capacity of 1,000 tons instead of 648 tons.

CONDITIONS FOR RAPID DRYING.

All fruits and vegetables which can be pared, sliced or shredded will dry very rapidly. For example, 20 tons of potatoes, containing 78.3% moisture, can be dried per 24 hrs. in this same dryer, also 20 tons of sweet potatoes containing 69% moisture, or 12 tons of parsnips containing 83%, or 9 tons of tomatoes containing 94.3%, or 20 tons of carrots or turnips containing 88.2% and 89.6% moisture respectively.

When it comes to drying fruits unsliced, the capacity is very materially affected, as for instance blackberries, gooseberries, huckleberries, raspberries, strawberries, currants, etc., all contain from 82% to 90% of moisture, but only 3 to 4 tons can be dried per day of 24 hours in this same dryer, or from one-sixth to one-twelfth of the capacity when the product is sliced or shredded.

CAPACITY OF DRYER.

Several dryers have been designed by the writer, which have turned out an average of 30 tons of raw fruit daily, which contained 75% to 80% moisture, using an apparatus about two-thirds the size of what would be required in the foregoing example, but there is yet plenty of room for improvement. Such a dryer as outlined is about 50 ft. long, 6 ft. wide and about 12 ft. high, not including the drying apparatus. Usually trucks or cars with racks to support mesh-bottomed trays, carry the product, which is spread anywhere from ½ to 1 in. deep on the trays. Considerable ingenuity has been exhibited by some designers and patentees in efforts to get a perfectly even distribution of air circulation over the entire surface of each tray. Most of the patents granted simply cover this feature in combination with something else. Such methods always involve considerable handling and careful watching to keep up the continuity of the cycles of operation, or else the output will be below the maximum capacity.

The fruit dryer having 30 tons capacity above referred to, is an automatic belt dryer. There is no handling of the product from the paring and slicing machine to the packing room, all being done by conveyors, bucket elevators and chutes. The area of the conveyor in the drying chamber is about the same as the total area the trays would be for a car system, but the dryer is about 10 ft. longer on account of some waste space necessary at each end to accommodate the mechanism which operates the belts.

The first cost of one or the other is not much different, while the cost of maintenance and the saving of labor is decidedly in favor of the conveyor system. The employees who handle the trays, however, have a penchant for destroying them, also battering the cars or trucks; whereas they never have any occasion to touch a conveyor dryer. This is due partly to the fact that employees are not around a conveyor plant, as they are not needed to operate it.

DEHYDRATING FOODS BY VACUUM.

Another method of dehydrating foods is by vacuum. This, however, is too limited in capacity for serious consideration, unless a plant of huge proportions is installed, when it then parallels the cost and expense hereinbefore noted for refrigeration. The cycles of operation are bound to be slow and the labor cost excessive, with no compensating results other than can be obtained by the air circulation methods.

Probably a small outfit could be made which might be sold to the householder who has a little garden in his back yard, or who desires to put up vegetables and fruits when they can be bought cheap in the summer. Those who have never tasted any dehydrated foods will be astonished at the results. When properly treated and prepared, it is impossible for the most critical observer to tell which is fresh and which was dehydrated.

The writer has interested himself in this subject more or less for some years, but never, before this year, has there been much to encourage any effort to devise something to meet the requirements. Even now, with the high prices prevailing and the insistent urging by the government that all food be carefully preserved, there does not seem to be much likelihood of anything being done on a scale of such proportions as will go very far toward relieving the situation.

It will take years to get the farmer interested so that he will take active steps in that direction. Likewise, it will take a long time to interest the capitalist in such a project, when there are so many tried and proven opportunities for safe and profitable investment in things he knows more about, which are closer to him and in lines of business where he can deal with business men instead of farmers, who are not always noted for doing things in a business-like manner.

Without intending to criticize in the slightest degree but rather to suggest what appears like a more practical way of dealing with the food situation, than is proposed by the national authorities, it seems as though it would be wise to turn attention to the establishment of dehydrating plants in all of the existing canning factories. Such concerns have the organization to get the product from the farmers and to market it afterwards, both of which are big and serious problems for any new concerns to undertake.

Most canning factories have the power, the room, the men and the inclination to undertake it. All of them combined are likely to be unable to successfully handle the crop this year by the old method, because they can not obtain tin enough to make the cans. With a dehydrating plant as an auxiliary they could turn out both kinds of product, and perhaps take care of the crop. Many of them lack money to do it, in which case the government should loan it to them on long time and easy terms. If all the crops, which there is every prospect will be raised this year, could be dehydrated before marketing, excluding wheat and corn, there would probably be 150% more than is required, as undoubtedly 60% of the stuff raised goes to waste before it is consumed as food by the individual householder.

The freight saved in transportation by railroads and ships, the warehouse space saved, the cleanliness, the prevention of the boosting of prices by cold storage warehouses (as so many think is done), in fact, everything one can think of favors dehydration, and at present every known substitute fades into insignificance by comparison.

Hot Water Heating System of Crane Co. Chicago Works

By F. E. McCREARY, Engineer Crane Company.

(*Read at the summer meeting of The American Society of Heating and Ventilating Engineers, in Chicago, July 18-20, 1917.*)

After considerable time had been spent investigating the various heating systems applied to large manufacturing plants, hot water heat under forced circulation was adopted as the best system to install for the particular conditions at the new plant of the Crane Company. The plant comprises a plant of 160 acres, 151 of which are effective for building purposes. It is bounded by Kedzie Ave. on the east, extending back to the Santa Fe Railroad shops on the west, by 39th Street on the north and 43rd Street on the south. A total building frontage of 2,470 ft. is set back 150 ft. from Kedzie Ave.

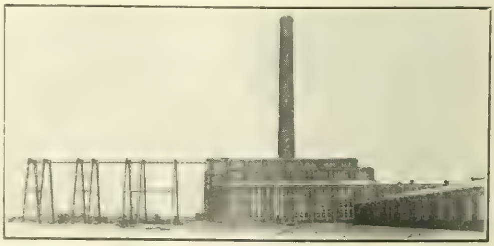
From north to south, the buildings are divided into six groups, lettered from A to F. Each group extends westward from Kedzie Ave., numbered consecutively. The A and F groups receive the raw material, and it is passed through the works systematically, and the finished product delivered for shipment from the central group.

The finished plans call for the erection of about fifty buildings, having a floor area of about fifty acres. Most of the buildings are of the two-story type, with no basements. The office building fronting the center group is five stories high. All the buildings are of modern reinforced concrete construction.

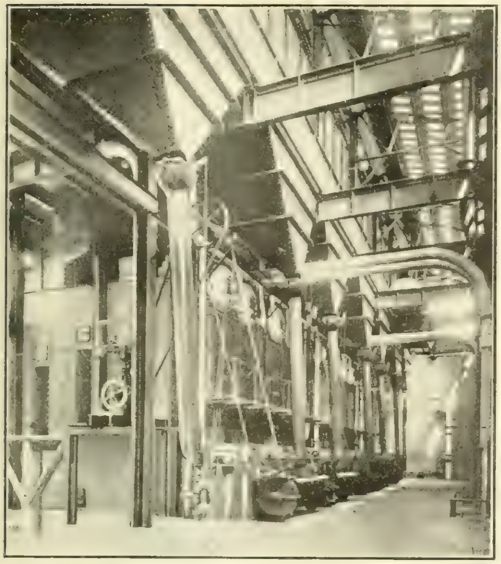
The completed manufacturing plant was estimated to cover the land east of the boiler house, and the total estimated amount of radiation to be about 450,000 sq. ft. of which at present exclusive of the office building, there is 300,000 sq. ft. in service; the balance is to be completed in the next few years.

The boiler plant, described hereinafter, is a steam service station for the works, supplying power for air compressors and heating equipment only, and steam for domestic hot water service, testing, etc.; exhaust from compressors and pumps is turned into the heating system and contributes its part to the general result.

The plant is divided into six 9-in. cir-



POWER HOUSE, CRANE COMPANY PLANT.



VIEW OF BOILER ROOM.

cuits, each controlled from the boiler house direct. As the office building would have to be operated at times when there was no need of heat on the works, and particularly to reduce the pumping head for the works circuits, a separate and duplicate equipment was installed for this building, which at present contains 13,240 sq. ft. of direct radiation, including the mains. The equipment in the boiler house was made large enough to handle three more stories, which would give a completed total of radiation of 21,640 sq. ft.

The office building supply mains are so arranged on the ceiling of the fifth floor that they drop to the floors below, and so the first one fed is the last one picked up on the return main, which is located on the ceiling of the first floor.

All radiators run in size from 70 sq. ft. to 130 sq. ft. and are fed at the top with the return at the bottom. The size of feed and return in all cases has been made one inch, each supply and return having a brass gate valve with union made thereon. All the fittings from 2 in. and down are standard screwed; from 2½ in. and up No. 1 long sweep ells and No. 2 long sweep double branch elbows and crosses, the sweeps turned in direction of flow. These fittings greatly minimize the friction in the system and tend to a more rapid circulation. They were all bushed in the sand, thereby cutting down the number of screwed joints.

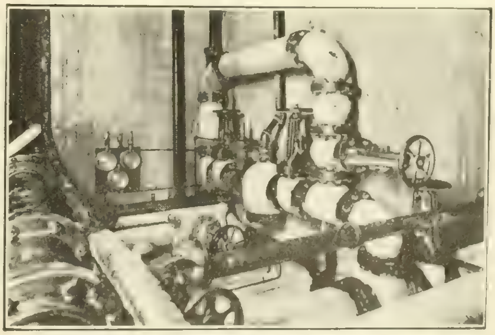
About the 22nd of August, a year ago, on a very cold, raw day, the office circuit was started and in 25 minutes the water was up to 110°; then the heat was turned off and the building was very comfortable the rest of the day.

Length of travel of water in office circuit is 2,630 ft., the static head on office 33 lbs., the pump discharge gauge, 48 lbs., or 15 lbs. maximum friction head (34.88 ft. or 1.33 ft. per hundred), which is well within the limits of 2 ft. per hundred on which the plant was figured.

We have divided the works heating system off into six circuits, each controlled direct from the boiler house. As previously mentioned, this arrangement gave a less static head to work against and allowed for greater flexibility of pumping water to the more exposed buildings. When starting up the works system it ordinarily takes 4½ hours to bring it up to temperature.

The boiler house and buildings are connected at present through the following lengths of tunnels:

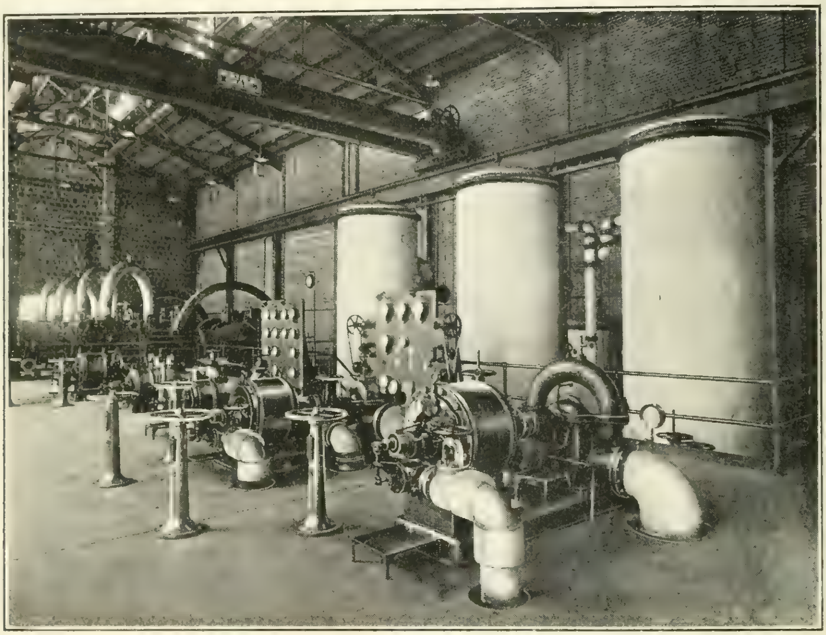
770 ft. of 15-ft. wide tunnel
1310 ft. of 8-ft. wide tunnel.
1638 ft. of 6-ft. wide tunnel.



DIFFERENTIAL CONTROL VALVE FOR CONTROLLING HEATING SUPPLY TO BUILDINGS.

Present	3718 ft. of tunnels.
Proposed	1260 ft. of 6-ft. (future) tunnel.
Total	4978 ft. of completed tunnel system.

Seven expansion pockets are provided at present in the tunnel system for taking care of expansion of all the piping mains. All the mains are hung on 10-ft. centers from the flanges of beams throughout the tunnel system which are left bare to expedite the hanging. In the mains, one-half of the figured expansion was taken up cold; bends were used wherever possible.

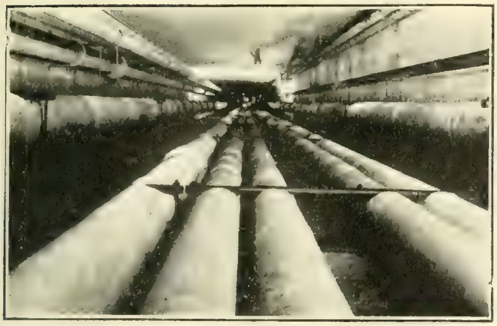


HEATING EQUIPMENT AND COMPRESSORS IN POWER HOUSE.

At each building there is left a 30-in. square opening for the lines which serve it; a 2 × 15-ft. opening in ceiling of expansion pockets and a 2 × 8-ft. opening are left on main runs of tunnels to facilitate the installation of the piping. Every endeavor has been made to standardize the construction as far as possible.

In the shop buildings, which are mostly two-story structures, the supply and return mains are hung from the ceilings of the second and first floors respectively, close up to the walls above the windows, so as to facilitate the hanging of countershafts, etc. Connections are made to the mains so that the first coil fed is the last coil picked up on the return, thereby balancing the flow of water to the coils, which prevents short circuiting and tends towards a uniform distribution of water. To further regulate the supply of water to the coils a lock and shield valve is installed on both supply and return near the mains. It has been found that the best practice is to leave the feed valve wide open and check on the return. One of the main reasons for installing lock and shield valves was to prevent everybody tampering with the system.

On the first section of the buildings, the size of feeds and returns was cut down to what was the general practice for gravity work. Our second floor coils, now the feed connections, have been made 1-in. As the first floor coils are being fed on a drop leg, the sizes were made larger than the second floor. The coils are made of 1½-in. pipe and are eleven pipes high, double and single. They are mitered up to the pilasters between the windows. All the coils are run level and are supported every 10 ft. by



THE MAIN PIPE TUNNEL, 15 FT. WIDE.

a specially designed cast-iron support, which is set in the concrete floor and held to window frames with two ⅜-in. lag screws (see Page 33).

The main reason why pipe coils were installed instead of cast-iron radiation is that the pipe coil will withstand the harder shop service. All supply and return connections to radiators are made with special center back-outlet return bends, union ells and tees of the railroad type, thereby cutting down the number of joints to a minimum. The setting of sleeves in floors has been reduced to a standard, thereby expediting the work of steam fitting.

AIR REMOVAL.

The greatest thorn in the side of all heating systems is the removal of air therefrom. The greatest trouble with all air removal devices is that the outlets are entirely too small and any dirt from the lines clog them up, thereby making floats stick, allowing the water to come through. Air always hunts the high points; and as all radiators on this job have a top feed and bottom return, the air works up through the coils and risers to the feed main on the second floor ceiling.

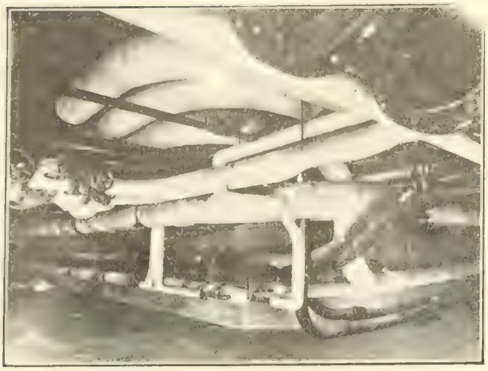
In the last buildings, the ends of the feed mains have been tied together with 1-in. lines with sediment traps (that come with traps) which connect to a ½-in. special direct-return air-venting trap, located above the feed mains. The supply side of this trap is connected to it with an air chamber, which in turn is hooked up to the aforementioned 1-in. lines. The top of the air chamber is connected to the trap body with a ⅜-in. armored air hose.

The water rises and fills the trap, and as the air comes into the system it rises to the air chamber and displaces the water in the trap until the water is all driven out when the counterweight of the trap drops and releases the air to the atmosphere, after which the water rushes in and completes the cycle. The beauty of this scheme is that it embraces a sediment trap which is blown out occasionally and it vents through larger size openings. One trap has been in operation now two seasons and they are now installed throughout the whole plant. The relief of air from the system has a great deal to do with the life of the equipment and the results obtained.

ARRANGEMENT OF TUNNEL LINES.

Leaving the heating equipment in the buildings and entering the tunnels going toward the power house, all the mains of the buildings are connected into them through a differential control valve for controlling the amount of water to supply the radiation in each building. A J. C. Hornung differential control valve is

A SECTION OF THE 6-FT. WIDE TUNNEL.

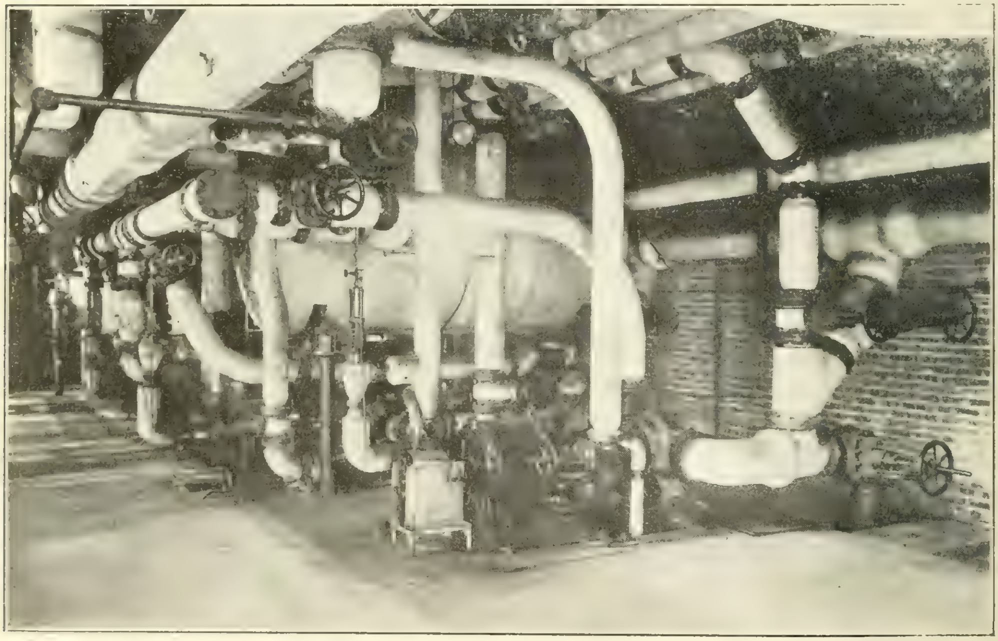


JUNCTION OF THE 15-FT. AND 8-FT. TUNNELS.

used to regulate the difference in pressure between the supply and return of the service pipes, as otherwise the buildings nearest the pumps would circulate under the greatest differential and, due to the friction in the mains, the differential would decrease toward the end.

One advantage with this valve is that it can be adjusted to meet any change in amount of radiation added to or taken from the buildings. The valve is of the balanced type, actuated by a diaphragm and is installed in the supply serving the radiators. Being of the self-contained pattern, no control pipe is needed, as the reduced pressure acts internally along the stem upon the diaphragm. The return main from the system of radiators under control is given a connection to the bottom side of the diaphragm, so that the reduced pressure in the supply main acts upon the top side of the diaphragm and the pressure in the return main acts upon the opposite side of the diaphragm. This would at once tend to place the valve in such a position that no water would pass through it, as equal pressure will prevail on either side of the diaphragm. If now the adjusting screw is turned to compress the spring on the lever side of the diaphragm, a new balance prevails whereby the pressure on top of the diaphragm which is the reduced supply pressure must equal the return pressure, plus the pressure exerted by the spring.

In the practical application of the differential valve, the spring pressure represents the friction head in the system of radiators under control. The valve is adjusted for proper friction head to



DOMESTIC HOT WATER HEATERS AND PUMPS IN BASEMENT OF POWER HOUSE.

maintain the desirable circulation and maintains the head or differential regardless of fluctuations in either supply or return.

Regarding the figuring of mains, a friction drop of 2 ft. in 100 ft. was taken as a base on which our plant was designed. The longest travel of the water from the pumps through the mains and back to the heating equipment is 4,500 ft. or 34 lbs. maximum friction head, or, reduced to feet, practically 79 ft.; this is 1.75 ft. per 100-ft. run, which comes well within the limits prescribed.

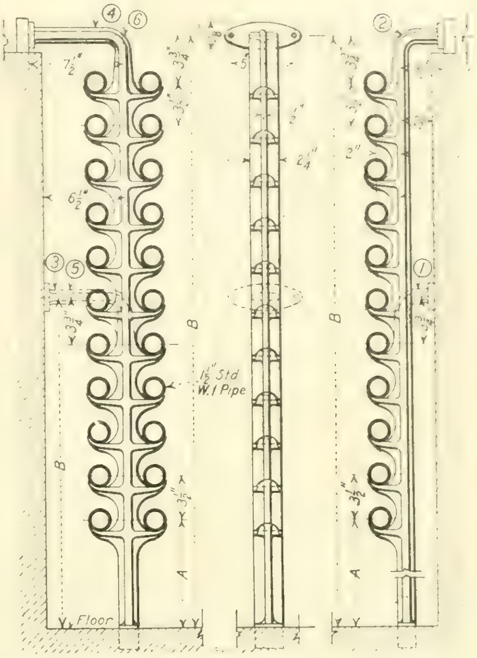
Two pumps were in service this past winter operating at the following rate:

Pump	Delivery gal. per min.	Speed r.p.m.	Percentage of Rating
No. 1	3000	1385	86
No. 2	2323	1600	66
Total	5323 gal. per min.		

Rated capacity

3500 gal. per min. at 1600 r.p.m.
3500 gal. per. min. at 2400 r.p.m.

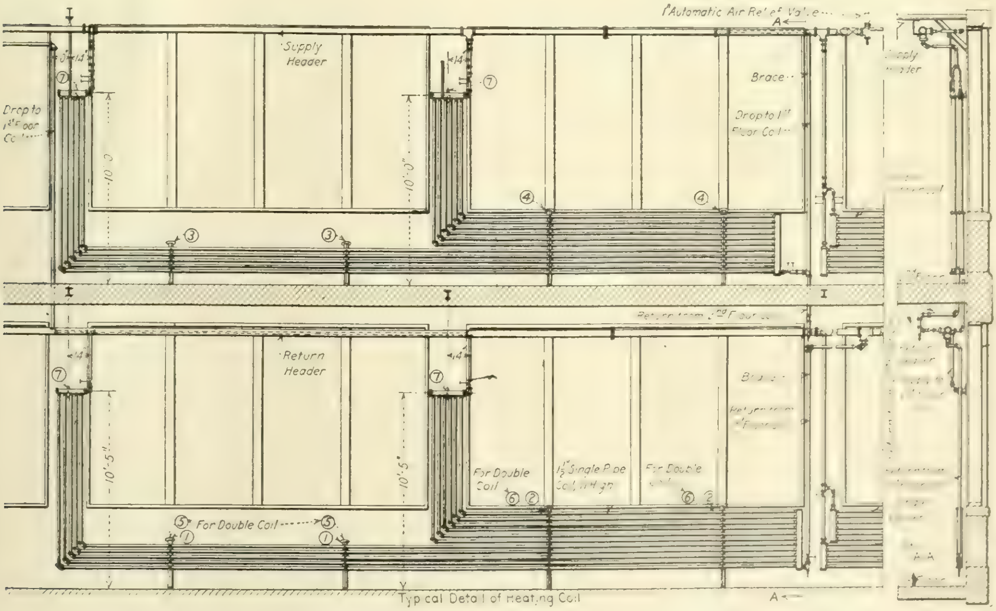
5,323 gal. per min, for 300,000 sq. ft. of radiation reduced to pounds per square foot per hour at an average temperature of 125°, or 8.21 lbs. per gallon, gives 8.75 lbs. of water per square foot per hour.



DETAIL OF PIPE COIL SUPPORTS IN BUILDINGS.

The layout was estimated on 9 lbs. of water per square foot per hour.

Two 5 × 12-ft. expansion tanks are connected together and a 3-in. line runs

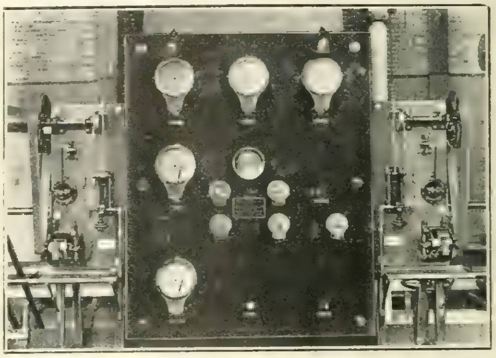


TYPICAL DESIGN OF HEATING SYSTEM FOR ONE SIDE OF A BUILDING, CRANE COMPANY PLANT.

down and is connected into each return line to the pumps. The overflow from each of these tanks was connected into the two 20,000-gal. storage reservoirs under the test room floor. The water supply to the expansion tanks is controlled by a float valve and the expansion tank overflow level is 33½ ft. above the boiler room floor line. The highest feed main is 30 ft. above the boiler room floor line. When the water returns to the boiler house it goes through three 12-in. volute pumps driven by three 125-h.p. direct connected Kerr steam turbines. The writer would like to advise the use of 1,600-r.p.m. pumps for this service, instead of 2,400-r.p.m., as there is likely to be less trouble with the slower speed equipment.

After the water has passed through the pumps and the three 3,600-sq. ft. two-pass type heaters of 484 2 in. by 14 ft.-long tubes, it is returned to the buildings at the required temperature under the control of a Powers system of temperature regulation. The flow line leading from each heater is provided with a thermostat operated by compressed air, and this thermostat controls automatically a diaphragm valve mounted on the steam supply to the heater. The thermostats are adjusted over a considerable range of temperature by means of adjustment switches located on the service board on compressor-room floor. This service board carries in addition to the adjustment switches for the several heaters, a set of Bristol temperature recording thermometers, for each of the heating circuits. These thermometers are of the double registration type, and their sensitive bulbs are located in both flow and return lines, so that the recording charts present a continuous record of the water temperature as it leaves the power house, also as it comes back. The operating engineer by observing the outdoor weather conditions, may set his adjustment switches to send the hot water out on the various circuits at the proper temperature and thus have before his eye or ready for observance, the apparatus and the amount of heat given out from the different circuits from the time the hot water leaves the station until it returns.

Compressed air for the operation of this system is supplied by electric motor-driven compressors, installed in duplicate, one on each side of the service board. These compressors are under automatic control, operating only when necessary to maintain the 15-lb. air pressure used in the operation of the control system. Along the south wall of the compressor room are indicator floor-stands for the manipulation of the main valves in the various circuits.



TEMPERATURE REGULATION SERVICE BOARD IN POWER HOUSE.

CONDENSATION AND LIVE STEAM.

A float-chamber on the side of a heater controls the removal of the condensation for every two heaters, the pump discharging into two open feed-water heaters operated in parallel and belonging to the boiler plant. Should the feed-water heaters be out of service, the condensation may be discharged into the large service reservoir under the building.

A 10-in. connection is made to the 150-lb. saturated steam supply. This 10-in. line contains a Crane strainer and branches out into two 6-in. lines, leading into two 6-in. Crane pressure regulators which reduce from 150 lbs. pressure down to 2 lbs. back pressure, which the air compressors run under. In all cases where possible a strainer should be installed which would afford protection for the regulator.

BOILER HOUSE.

The boiler house which serves the plant is located 920 ft. back from Kedzie Ave. and 100 ft. south of the axis of the plant. The location of the various equipment was carefully studied with the main idea of accessibility and to occupy the least amount of space.

In the boiler room there are six 5,080 sq. ft. Babcock & Wilcox water tube boilers, built to withstand 200 lbs. working pressure, and running under 150 lbs. working pressure. Each boiler is served by a Bayonne chain grate stoker with 102 sq. ft. of grate surface, a ratio of 1 to 50. There is also one 2,540 sq. ft. Babcock & Wilcox water tube boiler built for 350 lbs. working pressure served by a Bayonne chain grate stoker, with 51 sq. ft. of grate surface, a ratio of 1 to 50. There is one separately-fired superheater of the three-pass type capable of raising 5,000 lbs. of steam an hour at 350-lb. pressure to a total temperature of 800°.

The boilers and superheater are served by a steel breeching lined with 1½ in. of vitrified asbestos board and ½ in. asbestos finish. Through an opening of 134 sq. ft., the gases are discharged into a Custodis radial-brick stack having an inside diameter of 12½ ft. and rising 225 ft. above the boiler room floor line.

Coal is taken from cars by a Shepard two-drum monorail crane equipped with a 1½-yd. bucket. From the cars to the bunkers the crane has a capacity of 50 tons of coal per hour. Individual bunkers serve each boiler and coal is chuted directly to stoker hoppers.

Steam is conveyed from each battery of boilers by two 6-in. leads to a steel manifold in the basement, and this manifold has an 8-in. connection to each air compressor, and also an 8-in. connection to the main 10-in. steam header for supplying the heating system. There is also a 5-in. line off of the center which serves the 5-in. auxiliary header supplying the pump room. Each manifold has a drip pocket which is served by a Cranetilt non-return trap that returns the condensation to the feed water heaters. The installation of these manifold headers takes all the steam from the boilers to the lowest point in the system, where it is relieved of a large part of the condensation, thereby reducing the liability of water going over into the air compressors. Steam to the air compressors is passed through extra-heavy receiver steam separators, of ample size to reduce pulsations.

WATER SUPPLY.

A 10-in. city water line extends the full length of the pump room to supply the various pumps and heaters. Two 3-in. lines serve two reservoirs each of 20,000-gal. capacity, located under the test room floor. These reservoirs serve the pumps through a 12-in. suction line, the end of which terminates in the 4,000,000-gal. pond out west of the boiler house. The boilers are served by two Blake-Knowles pot-valve plunger pumps, each rated to handle 4,000 boiler h.p. There is a specially designed cast-steel air chamber connected on the discharge of each pump and anchored to the ceiling; these chambers each weigh 2,200 lbs. These pumps take their water from two 2,500 h.p. Cochrane open-type feed water heaters.

AIR COMPRESSORS.

The air compressor plant consists of two 2,500-cu. ft. and two 4,375-cu. ft. cross compound Allis-Chalmers air compressors, delivering air at 90 lb. pressure to the works, a total combined installed capacity of 13,750 cu. ft. The high-pressure air cylinders from each engine discharge into a receiver and through leads from each of these receivers to a 12 in. air main, which terminates in 8 in. north and south mains in the east lateral tunnels.

The large foundry buildings on the north and south of the works have 5-in.

mains running the entire length of the buildings. These 5-in. mains each have three 42-in. × 10-ft. diameter receivers connected to them. There are at present installed in the various buildings nineteen of these receivers, which are all tested to 165 lbs. hydrostatic pressure. On all the air piping standard malleable screwed fittings, standard gate valves and Crane n.ine cocks were used.

HOT WATER.

The hot water for domestic service is supplied by two Baragwanath type heaters of 5,000 gals. per hour, each 5½ ft. diameter by 10 ft. long, having 490 sq. ft. of 1½-in. No. 15 gauge brass tubes 46 in. long. The exhaust steam is supplied through a Powers regulator diaphragm valve and the make up steam through a Crane pressure regulator. Three Worthington Kerr-turbine-driven pumps serve the above heaters and deliver the water to the 6-in. circulating mains throughout the tunnels.

All the piping on domestic hot water, air lines, service and heating mains in the tunnels are standard steel pipe with standard ferro-steel Cranelap flanged pipe and ferro-steel flanged fittings from 6 in. and up; from 2½ in. to 6 in., the piping is standard cast-iron flanged and from 2 in. and down it is standard cast-iron screwed. There is also an 8-in. service main which serves the boiler house, filling the heating system and fire service throughout the works. The aforementioned pumps can be used either on service, domestic water lines, air compressor jackets, or ice machine coils.

DRINKING WATER SUPPLY.

A 30-ton Carbondale absorption refrigerating system cools the water for 140 drinking fountains now installed. About 225 fountains will be in service when the works are completed. The generator is built for 50 tons capacity and additional condenser coils will be installed in the near future. The ice machine and air compressor jackets are supplied through an 8-in. suction line from a pond of 4,000,000 gals. to the west of the boiler house by an 800-gal. Lea-Courtenay turbine driven centrifugal pump.

* * *

Air Cooling Schemes for Houses.

Speaking on the subject of "Prizes for the Inventor" before the graduating class of the McKinley Manual Training School in Washington, Dr. Alexander Graham Bell told the graduates about the experiments he had been conducting for cooling the air in his own home and emphasized the possibilities in this direction. This part of his address as published in the *National Geographic Magazine,* is given herewith:

The problem of cooling houses is one that I would recommend to your notice, not only on account of your own comfort, but on account of the public health as well.

I have found one radical defect in the construction of our houses that absolutely precludes the possibility of cooling them to any great degree. You will readily understand the difficulty when you remember that cold air is specifically heavier than warm air. You can take a bucket of cold air, for example, and carry it about in the summer-time and not spill a drop; but if you make a hole in the botom of your bucket, then, of course, the cold air will all run out.

Now, if you look at the typical tropical houses, you will find that they are all open on the ground floor. Supposing it were possible to turn on a veritable Niagara of cold air into a tropical house, it wouldn't stay there five minutes. It would all come pouring out through the open places below and through the windows and doors. If you want to find your leakage places, just fill your house with water and see where the water squirts out!

I began to think that it might be possible to apply the bucket principle to at least one room in my Washington home, and thus secure a place of retreat in the summer-time. It seemed to be advisable to close up all openings near the bottom of the room to prevent the escape of cold air and open the windows at the top to let out the heated air of the room.

DR. BELL'S OWN EXPERIMENTS.

Now, it so happens that I have in the basement of my house a swimming tank, and it occurred to me that since this tank holds water, it should certainly hold cold air; so I turned the water out to study the situation. The tank seemed to be damp and the sides felt wet and slimy.

I reflected, however, that the condensation of moisture resulted from the fact that the sides of the tank were cooler than the air admitted. Water vapor will not condense on anything that is warmer than itself, and it occurred to me that if I introduced air that was very much colder than I wanted to use, then it would be warming up in the tank and becoming dryer all the time. It would not deposit moisture on the sides and would actually absorb the moisture there.

I therefore provided a refrigerator in which were placed large blocks of ice covered with salt. This was placed in another room at a higher elevation than the tank, and a pipe covered with asbestos paper was employed to lead the cold air into the tank.

The first effect was the drying of the walls, and then I felt the level of the cold air gradually rising. At last it came over my head. The tank was full, and I found myself immersed in cool air. I felt so cool and comfortable that it seemed difficult to believe that Washington stood sizzling outside. I climbed up the ladder in the swimming tank until my head was above the surface, and then found myself breathing a hot, damp, muggy atmosphere. I therefore speedily retreated into the tank, where I was perfectly cool and comfortable.

Guided by this experience, I tried another experiment in my house. I put the refrigerator in the attic and led the cold air downward through a pipe covered with asbestos into one of the rooms of the house. The doors were kept shut and the windows were opened at the top. The temperature in that room was perfectly comfortable, about 65° F.

At that time the papers were speaking of some ice plant that had been installed in the White House and congratulated the President upon a temperature of only 80° F. when the thermometer showed 100° outside. At this very time I enjoyed in my house a temperature of 65°, with a delicious feeling of freshnes in the air. Even when the air had risen to the same temperature as the rest of the house, as measured by a thermometer, the room still felt cool, because the air was drier, thus promoting perspiration that cooled the skin.

SELLING COLD AIR IN PARIS.

In this connection I may say that there is a very interesting cooling plant in Paris, France, run by the Societé de L'Air Comprimé. Very many of the cafés and restaurants in Paris have cold rooms for the storage of perishable provisions, and these rooms are cooled by compressed air supplied by this company.

The plant consists of large pipes laid down under the streets of Paris, with small branch pipes leading into the cafés and restaurants. At a central station steam-engines pump air into the pipes and keep up a continuous pressure of from four to five atmospheres. As there are several hundred kilometers of these pipes under the streets of Paris, they form a huge reservoir of compressed air at the ground temperature.

In the cooling room of a café they simply turn a little cock and admit the compressed air into the room. A gas meter measures the amount of air admitted and charges are made accordingly.

The compressed air, by its expansion, produces great cold, and the cooling effect is still further increased by allowing the air to do work during the process of expansion. Dumb-waiters, elevators, and even sewing-machines are thus run very economically in connection with the system by means of compressed-air engines.

WILL OUR CITIES BE ARTIFICIALLY COOLED?

Now, it appears to me that this process might very easily be developed into a plan for the cooling of a whole city. You would simply have to turn a cock in your room to admit the fresh air.

◆

A Heating System of Korea.

A novel heating system called *ondol* has been devised by the Japanese living in Korea so that they may withstand the rigorous winter climate of that peninsula. In this arrangement the whole floor serves as a stove. The floor is first made with a layer of mud which is intersected by three or four flues which radiate from the fireplace and converge into the chimney on the other side of the room. Large slabs of stone are laid over the mud floor, the joints being made air-tight with clay. A layer of clay is then added on top of the stone and finally the whole is covered with thick oiled paper.

The fireplace is outside of the wall and the smoke and heat pass through the flues in the floor to the opposite side of the house. In this way the whole room is effectively warmed. It is said that no stove is needed in such a room even on exceedingly cold days.—*From Bulletin 39 of the Japan Society.*

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IN the bustle and hurry of putting the country on a war basis it is apparent now that many of the early warnings as to shortages in some lines of manufactured articles happily have been found unnecessary. For instance in a bulletin on "Substitute for Tin Cans," published some time ago by the Department of Commerce it was stated that in addition to the scarcity of tin, "the price of glass has steadily risen and has reached a point at which any large extension of its use for food containers is impracticable. At present fibre or paper containers of good quality are being produced in considerable and increasing quantities and, for many purposes, are supplanting glass and tin plate."

It was largely on the basis of this reported condition that the campaign was instituted for the mechanical drying of fruits and vegetables. While there has been some shortage of tin and glass containers the fact remains that an enormous reserve stock of eatables, surpassing anything heretofore known in this country, has been laid away in cans and jars against the extraordinary needs of the coming winter. Much good, however, has come from the agitation, for it has awakened the American public and particularly, heating and ventilating engineers, to the very great opportunities for creating a market in this country for dried foodstuffs. Government and other experts have given out valuable information as to the design and operation of the necessary equipment, much of the information, as is well-known, having previously been unavailable to the trade. With this advantage heating engineers will have none but themselves to blame if they do not step in and obtain their full share in the development of the food-drying industry.

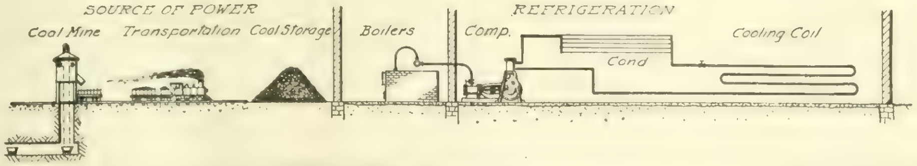
For long after the war it is predicted that Europe will be dependent on the United States for much of its food supply and there, at least, the demand for dried fruit will be long and continuous.

◆

NEXT month THE HEATING AND VENTILATING MAGAZINE will publish its second annual smokeless boiler number. Since the previous issue devoted to this subject, which appeared last October, the demand for fuel conservation has taken on new significance. Coal prices have soared to unheard-of heights and even with the intervention of the government, it is evident that we have entered a new epoch in the consumption of fuel. On top of this there is the present national call for the utmost economy in coal consumption, a call that appeals to the heating engineer as well as to the consumer.

The list of contributors to the smokeless boiler number will include men who have been most closely identified with the national campaign for the elimination of smoke, while other contributors will discuss the coal situation and the growing necessity for adapting boilers of all sorts to the smokeless burning of soft coal.

AIR COOLING AND REFRIGERATION



Application of Absorption System of Refrigeration

Having considered the theoretical end of absorption refrigeration, its practical application as embodied in commercial apparatus will now be discussed. For this purpose the apparatus manufactured by the Carbondale Machine Co., of Carbondale, Pa., may be taken as a good example of standard equipment.

In Fig. 1 is illustrated a complete absorption refrigeration plant with explanatory designations of the various parts and piping. The method of operation is to fill the generator with aqua ammonia sufficient to cover the steam coils, and the absorber with enough to cover the water tubes. Then the brine circulation through the brine cooler is started and the cooling water is turned on at the point marked "Water Inlet"; the water enters the lowest head of the condenser, travels through the condenser, then to the absorber, thence to the weak liquor cooler and lastly to the rectifier. By thus using the same water through four parts, in series, economy of water is obtained and the cost of operation kept low.

Steam is then turned into the generator coils and the evaporation of the ammonia therein builds up a pressure in the generator, condenser, and rectifier, rising until sufficient pressure is developed to condense the gas in the condenser. As the gas passes through the rectifier the cooling water reduces its temperature so that moisture, entrained in the gas, separates from it and returns to the generator through the drip pipe while the gas condensed in the condenser falls into the "Anhydrous Receiver." The liquid ammonia is then allowed to pass through the expansion valve into the brine cooler where it expands and absorbs heat from the brine.

The weak liquor left in the generator after the expulsion of the gas is drawn from the bottom of the generator through the heat exchanger into the weak liquor cooler and from there into the absorber where it meets the gas coming from the brine cooler and absorbs the gas. By this absorption the weak liquor becomes strengthened and is then strong liquor which is drawn into the suction of the ammonia pump and is discharged through the heat exchanger back into the generator.

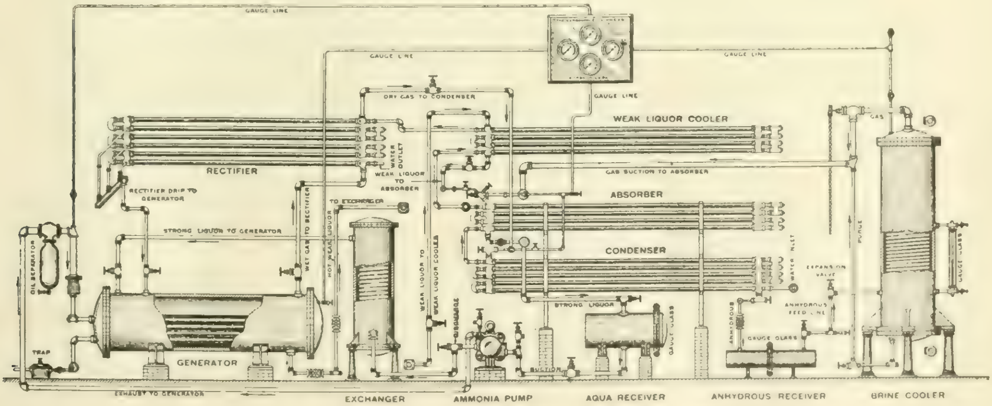


FIG. 1 COMPLETE ABSORPTION REFRIGERATION PLANT.

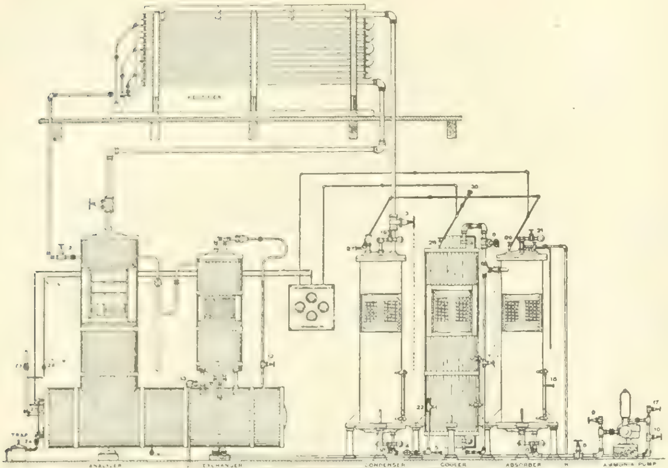


FIG. 2—ARRANGEMENT OF "SHELL" TYPE MACHINE.

SHELL-TYPE MACHINE, FOR USE WITH CLEAR WATER.

This refrigeration manufacturer provides plants of three types—the first and older type being illustrated in Fig. 2 and known as the "shell" type machine. It is particularly suited for conditions where condensing water is obtainable which is free from incrusting solids and dirt. Although of older design than some of the other equipment made, these plants operate with good efficiency and several have run for periods of over twenty years without renewals of apparatus.

ATMOSPHERIC TYPE, FOR USE WHEN COOLING WATER IS DIRTY OR WARM.

For cases where dirty or warm cooling water is encountered the second type of apparatus known as the "atmospheric" is used, this being illustrated in Fig. 3. With this equipment the rectifier is placed under the weak liquid cooler so that the water is first used on the cooler before descending to the rectifier. In like manner the condenser is placed above the absorber so that the condensing water is also used over the absorber.

DOUBLE-PIPE TYPE, LATEST DEVELOPMENT.

The third type of machine consists of a generator similar in design to the preceding types, and the rectifier, exchanger, weak-liquor

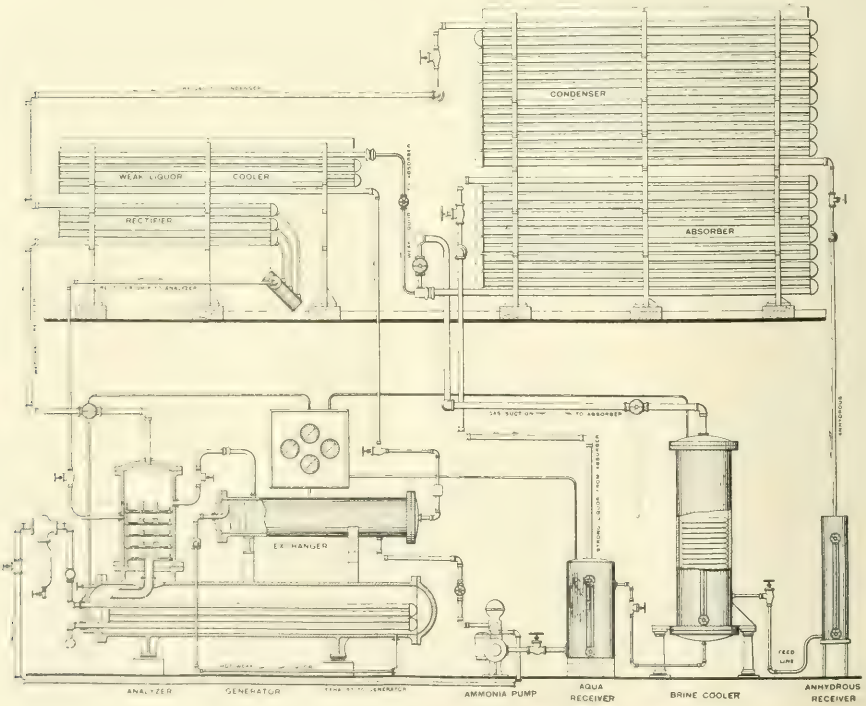


FIG. 3—ARRANGEMENT OF ATMOSPHERIC TYPE MACHINE.

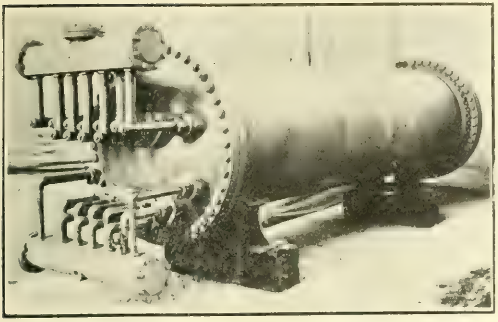


FIG. 4—STEAM GENERATOR FOR ABSORPTION REFRIGERATION SYSTEM.

cooler, condenser and absorber are all double-pipe construction. This is particularly adapted for low heat-room and is easily accessible. Containing nothing but straight pipes, it can be readily inspected and cleaned.

PARALLEL PROCESSES BETWEEN HEATING AND REFRIGERATION IN ABSORPTION SYSTEMS.

It is most interesting for the heating engineer to trace the parallel processes between heating and refrigeration; in fact, this analogy has been pointed out before for compression systems, but it can also be closely followed in absorption systems.

Take, for instance, the strong liquor after passing through the absorber; it is seized by the ammonia pump (boiler feed pump) and pumped back through the exchanger (feed water heater) into the generator (boiler) where the aqua ammonia is heated by the coils (fire) until it generates anhydrous ammonia gas (steam). The gas (steam) passes out through the rectifier (steam separator) and ultimately reaches the expansion valve and cooling coils where it expands and does work just as steam does in an engine.

USING EXHAUST STEAM IN REFRIGERATING PLANTS.

It would seem that a refrigeration system using exhaust steam as a motive power would be the answer to the problem as to what to do with the exhaust steam in the summer time in the building power plant. If a power plant can be made more economical when the exhaust is only used for heating in the winter, how much more advantageous would it be to employ the same exhaust in the summer to produce refrigeration in all its many desirab forms?

The generators which constitute the heart of the absorption refrigeration system are built of cast-iron in smaller sizes and of lap-welded steel in the larger ones. The steam is fed into the upper manifold shown in Fig. 4, and from the manifold enters the pipe coils located inside the

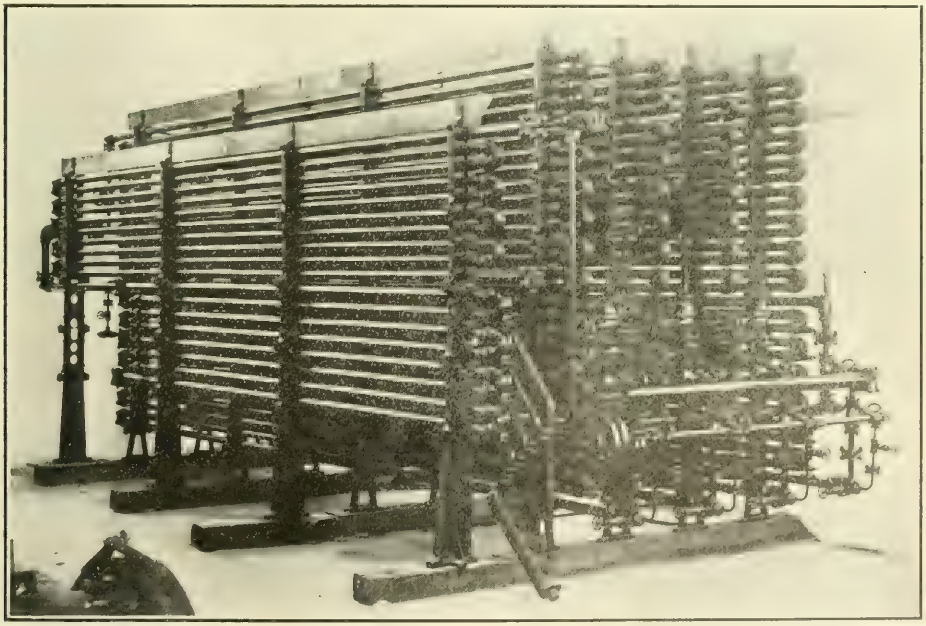


FIG. 5—ATMOSPHERIC CONDENSER, WITH ABSORBER BELOW AND WEAK LIQUOR COOLER AND RECTIFIER ALONGSIDE.

shell of the generator. As the steam condenses in passing through these coils the condensation flows out of the lower ends of the coils into the lower manifold, the action being in every way similar to a common hot water heater, heated with steam coils.

The condensers are either atmospheric, double-pipe, or shell type. As previously mentioned, the atmospheric type is best for muddy water or where scale is likely to be encountered. In the double-pipe condenser the flow of water is through the inside pipe and, as it is in a direction countercurrent to the ammonia, this type of condenser is very efficient. The shell-type is used where it is necessary to economize in floor space. A 50-ton condenser of this type requires only 5 ft. square floor space. Its chief advantage lies in the fact that it has a high water velocity in the coils, thus insuring a low condensing pressure and, besides, this has fewer joints than a double pipe condenser.

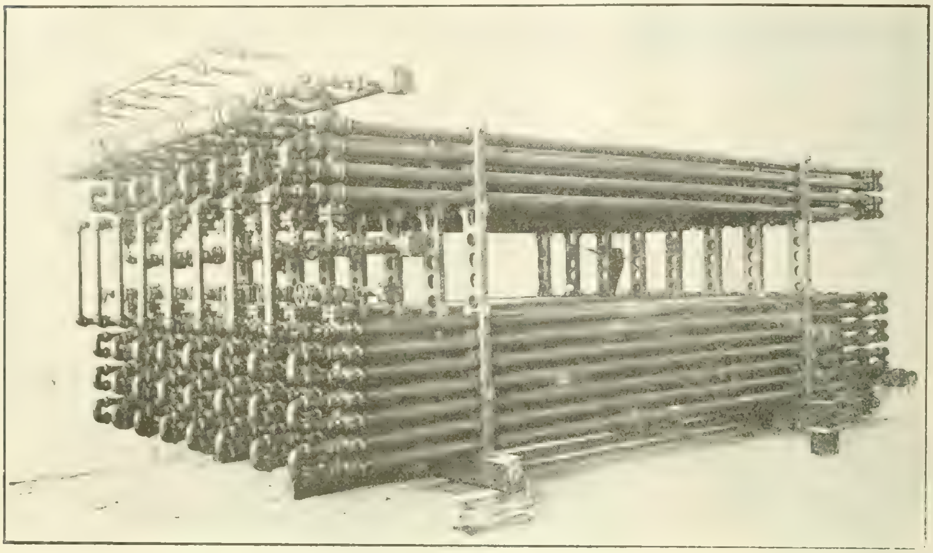
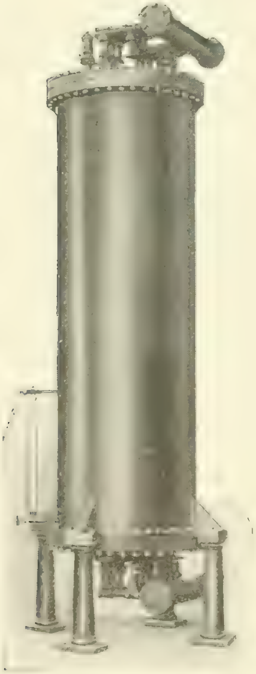


FIG. 6—DOUBLE-PIPE CONDENSER.



SHELL TYPE CONDENSER.

* * *

An apparatus for use in conjunction with ammonia absorption refrigerating machines for distilling off the gas contained in the aqua ammonia and thus generating anhydrous ammonia at a cost under 18 cents a pound, has been designed by the Carbondale Machine Co., Carbondale, Pa. This is accomplished without interfering with the operation of the refrigerating machine and does not require the closing of an expansion valve, as in the case of charging with anhydrous ammonia. The economizer is simple in construction and can be placed in any convenient spot in the engine room. Its operation requires no more attention than that necessary in the ordinary charging of anhydrous or of purging. The apparatus and its operation are described and illustrated in a bulletin (No. 17) issued by the company.

The War and the Heating Engineer

Chicago Commission on Ventilation Makes Definite Proposals for Changing Army Cantonment Construction.

A plan to furnish twice as much air space per soldier in the Rockford (Ill.) cantonment for the draft army as is at present proposed has been worked out by the Chicago Commission on Ventilation. The development of the plan was the outcome of the protest made by The American Society of Heating and Ventilating Engineers to the War Department, as reported in last month's issue.

Squad houses, for eight men each, instead of company houses for 200 men each, are proposed by the Chicago commission. Each building will provide 600 cubic feet of air per person.

"In the end," said Health Commissioner John Dill Robertson, "the small buildings will mean economy. If 200 men live together in one large room, it will mean that one man can give 200 men a contagious disease. When there are only eight in a room, at the most only seven can be infected."

Those present at the meeting were Dr. Robertson, William D. Harkins, J. W. Shepherd, Dr. E. V. Hill, Harry Hart, George Beaumont, John Howatt, James Davis, S. R. Lewis, M. J. Sturm, Fred Postel, Dr. C. P. Caldwell, and F. B. De Forest.

Heating Men in Military Service.

Charles L. Collette, advertising manager of the Kewanee Boiler Company, Kewanee, Ill., has been given a captain's commission in the Sixth Company, Infantry Section, Illinois Division of the First Officers' Reserve Corps. He has been training at Fort Sheridan, Ill.

Perry C. Satterthwaite, son of J. N. Satterthwaite, of Satterthwaite Bros., Tecumseh, Mich., heating and plumbing contractors, has been appointed a second lieutenant at Fort Leavenworth, Kan. He is a graduate of the University of Michigan, engineering department.

The following young men connected with the United States Radiator Corporation, Detroit, Mich., have enlisted for war service in the army or navy: Joseph A. Cook, Charles Crute, C. D. Rood, Percy Tuttle, William Wolpel, Harry N. Smith, A. H. Hanson, I. I. Hodes, T. R. Flanagan, John Keightly and G. L. Williams.

H. S. Rumsey, formerly vice-president and general manager of the L. M. Rumsey Mfg. Co., St. Louis, Mo., is now a captain in the First Missouri Artillery. Captain Rumsey is a veteran of the Spanish-American War.

William E. Sloan, Jr., son of W. E. Sloan, of Samuel Sloan & Co., Rochester, N. Y., has joined the Naval Reserves, at Newport, R. I.

M. Stanley Hunting, son of S. E. Hunting, president of the Hunting Co., Watertown and Rochester, N. Y., has been commissioned second lieutenant in the field artillery, having successfully passed the requirements at the Officers' Training Camp, at Madison Barracks, N. Y.

Charles G. Dennison, of the American Radiator Company, Chicago, has been commissioned captain in the new National Army. Herman A. Voss, of the same company, has been made first lieutenant, and Harold Pynchon, second lieutenant. H. L. Whitelaw has joined the Overseas Training Camp for Canadian Reserve Officers, at Toronto, Ont.

W. B. Hutchinson, son of Thomas H. Hutchinson, manufacturers' agent, New York, is a second lieutenant, having been commissioned last year. He is a graduate of Cornell University and has served at the Plattsburg Training Camp during the past few months.

A. W. Clegg, of F. A. Clegg & Co., Louisville, Ky., has enlisted in the Quartermaster's Corps.

Building the Army Cantonments.

Neiler, Rich & Co., Chicago, Ill., have been selected as supervising engineers in charge of the heating for Camp Custer Cantonment, at Battle Creek, Mich. Both Mr. Neiler and Mr. Rich have been on the ground, and Mr. Rich will be located there permanently until the completion of the work.

Sarco Co., Inc., New York, has received orders for temperature regulators for each of the sixteen cantonment camps, as well as for the Selfridge Aviation Field, near

Mt. Clemens, Mich., and for the League Island Navy Yard, at Philadelphia.

An order for 2,000,000 ft. of pipe for government consumption was received by one of the Valley plants near Youngstown, O. Size of the pipe varies from ¾ to 7 in. It will be used to heat the different cantonments. The contract will be filled with the utmost dispatch.

The Home Furnace company, Holland, Mich., has received an order from the United States government for ten carloads of its product to be shipped as fast as they can be manufactured. The furnaces will be used in the army cantonments.

Howard Crook Co., Baltimore, Md., has been awarded the contract for the heating and sanitary equipment of the U. S. Army Cantonment at Charlotte, N. C. The Consolidated Engineering Company, Baltimore, has the general contract.

Stephan Bros., Council Bluffs, Ia., have received the heating and plumbing contract for the seven dormitory buildings and the seven mess buildings of the army cantonment at Fort Omaha. Each of the fourteen buildings is 336 ft. in length. The general contract was awarded to A. Wickham & Co., of Council Bluffs.

L. H. Prentice Co., Chicago, Ill., received a $100,000 government contract for heating the new buildings south of the present naval training station at Waukegan.

Farrell Heating & Plumbing Co., Atlanta, Ga., were awarded the heating and plumbing contracts for the seventh division army cantonment at Atlanta.

M. J. Gibbons Co., Dayton, O., were awarded the heating and plumbing contract for the eighth division army cantonment at Chillicothe, O.

Stone & Webster, Boston, Mass., were given the general contract for the army cantonment at Fort Sam Houston, Texas. This firm handles the entire equipment.

Colonel I. W. Littell is in general charge of all construction work for the new army cantonments each of which covers 1,000 acres of land and has 700 buildings, housing 40,000 men. All mail for the officer in charge of the work should be addressed to the constructing quartermaster of the camp in question.

Directions for Prevention of Fire.

The National Board of Fire Underwriters has prepared for the Council of National Defense and is mailing to a list of some 66,000 of the leading manufacturers of the United States, a booklet of directions for the prevention of fire, under the title of "Safeguarding Industry," together with a show-card of fire prevention rules for employees. Its purpose is to prevent fires in industrial plants which are working under the abnormal conditions of wartime emergency. The directions are brief and to the point and form a valuable contribution to the work of prosecuting the war. Copies of the booklet may be had, without expense, on request, by addressing the National board at 76 William Street, New York.

Recommendations of United States Food Administration.

Among the recommendations of the Bureau of Trade and Technical Press Publicity in connection with the food administration conservation campaign, is one to "save the fuel." "Coal comes from a distance" states the bureau, "and, our railways are overburdened hauling war material. Help relieve them by burning fewer fires. Use wood when you can get it."

Business Men in War Convention.

An emergency call has gone forth from the Chamber of Commerce of the United States to the business men of the country for a great war convention to be held at Atlantic City, September 17-21. It is expected to be the largest gathering of business men ever held and will show to the world that American business recognizes its duty in this crisis and stands solidly behind the government in war.

A principal topic of discussion will be the duty that business owes the government in war. The strongest possible emphasis will be laid upon this. There will come the question of how business of the country may render even greater service in winning the war. This will include what may be done to control prices, how priority may be most quickly and effectively established, how greater efficiency in land and water transportation shall be developed, how we may best provide for and protect our forces on land and sea and those dependent upon them at home, and what steps may be taken for better education of the nation on the issues at stake in the war.

Ways and means by which business must readily adjust itself to the conditions produced by the war will be considered. Also there will come the questions of how we shall provide for business enterprises not essential to the nation in war time, food conservation, its special importance to business men, industrial relations and employment problems, and foreign trade, banking and credit in war time.

Of particular interest will be the readjustment after the war for which business must prepare. This will include the question as to what will be the course of prices on raw materials and finished products after the war, how we shall plan for replacing our men in industry after they return from the war, and what new responsibilities in international relations may be expected after the war.

Engineering Council Appoints Committees.

Standing committees on public affairs, rules and finance have been appointed as follows by the Engineering Council which is made up of members of the civil engineers', mining engineers', mechanical engineers' and electrical engineers' societies:

Public Affairs: C. W. Baker, G. F. Swain, S. J. Jennings and E. W. Rice, Jr.

Rules: J. P. Channing, Clemens Herschel, N. A. Carle and D. S. Jacobus.

Finance: B. B. Thayer, I. E. Moultrop, Calvert Townley and Alex. C. Humphreys.

Many matters coming before the council, both from the several founder societies and from the council's predecessor, the Joint Conference Committee of National Engineering Societies, have been considered and referred to appropriate standing committees for investigation and report.

The council has also created a War Inventions Committee comprising H. W. Buck, A. M. Greene, Jr., and E. B. Kirkby, to co-operate with the Naval Advisory Board and other departments at Washington, if desired, in the promulgation to engineers of war problems now before the government and for which there are opportunities for solution by means of inventions. It also created a committee comprising George J. Foran, E. B. Sturgis, A. S. McAllister and A. D. Flinn, which is to collect and compile such information regarding engineers of the country as will enable the committee to co-operate with the different departments of the Federal government on request and to assist in supplying the government's need for engineering services.

Every effort is being made to secure the co-operation of all engineers, organized or otherwise.

American Efficiency.

Germany efficiency has been held up as a degree of excellence unattainable by a Democracy. The accomplishments of the United States since April 5 last refute the truth of the claim. In the short space of time since that day the United States has accomplished the following:

Declared a state of war as existing between this country and Germany;

Seized 91 German ships and begun repair work on them;

Authorized unanimously a war fund of $7,000,000,000;

Appropriated $600,000,000 for merchant shipping and as much for air fleets;

Agreed to loan our Allies $3,000,000,000 and advanced them a large proportion of that sum;

Passed a selective draft law and in a single day registered nearly ten million men for military service;

Enlisted 600,000 volunteer soldiers in the Regular Army and in the National Guard of the States;

Sent a Commission to Russia to aid Democracy there and a body of railroad men to Russia and another to France to advise and assist in railroad transportation in those countries;

Begun the construction of 32 camps for our soldiers;

Sent to England a fleet of destroyers and to France a detachment of troops;

Authorized and now enforcing embargo whereby our enemies will receive no more food or material from us;

Passed a food conservation law;

Organized many voluntary commissions and boards who are aiding the Government and the people in the speeding up of work, conservation of food, and other national movements;

Drafted by lot 687,000 men for military service;

While the Government was accomplishing these things the American people have loaned the United States $2,000,000,000 and offered $1,000,000,000 more, over four million citizens subscribing to the loan.

In addition they have given over $100,000,000 to the American Red Cross and $3,000,000 to the Young Men's Christian Association.

All these things were accomplished while our soil was not invaded or even threatened with invasion and without any disturbance of business conditions. All was done with the calm determination and judgment of an earnest, patriotic people performing a service for civilization and mankind and maintaining the rights, the dignity, and the honor of the greatest nation in the world.

The German leaders derided America's entry into the war as a bluff. This is our answer.

The German Imperial Government was nearly fifty years in perfecting its military efficiency. In less than four months the American Republic has made such strides as to indicate that in less than two years' time the boasted superiority of German efficiency will have been discredited. There is such a thing as American efficiency, and time will prove that German efficiency cannot withstand it, fighting as it is for liberty, justice, and humanity.

NATIONAL DISTRICT HEATING ASSOCIATION

Committee on National Defense.

Acting on the suggestion of J. W. Lieb, president of the National Electric Light Association, President George W. Martin has appointed a committee on national defense to work with the National Committee on Gas and Electric Service in securing the necessary coal supply next winter and during the continuation of the war. The national committee's headquarters are in Washington. The district heating association's committee is made up of George W. Martin, Secretary D. L. Gaskill, who is also president of the Greenville (O.) Electric Light & Power Co.; and J. C. Hobbs, of the Duquesne Light Co., Pittsburgh, Pa.

Questionnaires will be sent out to the member companies of the National District Heating Association covering their needs and requirements in regard to their coal supply. It is the intention of the bureau not only to see that the companies get an adequate supply of fuel, but also to obtain better shipments and routing and to obtain the lowest possible prices for the various utility companies.

Advancement Committee

As recommended by the retiring president, Byron T. Gifford, in his annual address, a new committee has been appointed, to be known as the Advancement Committee, to determine the possibility of financial gain in central heating work and to study the successful plants. The committee is composed of B. T. Gifford, chairman; A. E. Duram, New York; Charles R. Bishop, North Tonawanda, N. Y.; George H. Alexander, Frankfort, Ind.; D. L. Gaskill, Greenville, O.; George W. Martin, New York; and F. A. Newton, Jackson, Mich.

Increase in Coal Prices from 1915 to 1917.

Interesting figures as to the rapid rise in the price of coal during the past two years is furnished by various district heating companies in correspondence appearing in the bulletin of the National District Heating Association.

One company states that the market price of bituminous coal has increased from $4.50 in June, 1915, to $10.00 in June, 1917 per net ton. The second company reports that the average price for No. 4 washed nut coal was about $3.00 a ton in June, 1915. It is now $5.50 a ton. Screenings have increased $2.00 a ton. The average increase has been from 75% to 80%, the bulk of the increase having occurred during the past year. The third company reported a 50% increase, the fourth, a rise in average price from $1.58 to $3.50. The fifth company stated that screenings have increased in price from 75 cents per ton, on contract, to $3.25 in the open market, and mine run from $1.10 to $3.25. The sixth company gave comparative figures of $1.90 f.o.b. plant switch in June, 1915, and $3.50 in June, 1917, "the same for pea, nut and slack." The last company reported a rise from $2.00 to $3.25, or 62½%.

Increased Labor Costs a Factor in the Agitation for Higher Heating Rates.

Evidence that the need of higher rates for heating service are not based entirely on increased coal prices, is furnished in the reports of district heating companies on the cost of their boiler room labor. In one case the boiler room labor cost increased from 34⅜c. per hour in June, 1915, to 34⅝c. and 37½c. per hour in June, 1917. Approximately 60% of the employees secured this increase.

In another case it was stated that the increase in the cost of boiler room labor is to be found in the increase in the minimum rates of the local building managers' association. These rates have gone up 4c an hour since June, 1915, but as these rates are simply minimum rates, the advance has been greater. It is perhaps fair today that the advance has been about 20%.

One company reports an increase of 33%. The prices in 1915 were: Firemen (70 hours per week) 30c an hour; firemen helpers (70 hours per week) 25c per hour; laborers, 20c per hour. In 1917 they are: Firemen (60 hours per week) $95.00 per month; firemen helpers (60 hours per week) $80.00 per month; laborers, 25c per hour.

Wages paid by another company compare as follows: June, 1915: Firemen (12 hours per day) 23c per hour; firemen helpers (12 hours per day) 20c per hour; laborers (10 hours per day) 22½c per hour. In 1916, the prices were: Firemen 34c, firemen helpers 30c, laborers 30c. In 1917 the following wages prevail: Firemen (8 hours per day) 41c per hour; firemen helpers, (8 hours per day) 36c per hour; laborers (8 hours per day) 35c per hour.

How Much Must Heating Rates Be Increased to Meet Present Costs?

It is well-known that all of the central heating companies are face to face with the necessity of immediately increasing their heating rates to meet the present cost of coal, labor and supplies. Just how much an increase is necessary, however, is not so clear. Much light is thrown on this phase of the problem by the action already taken in a number of cases reported in the National District Heating Association's Bulletin for July, 1917.

Company A states that an increase of 35c per 1,000 lbs. of steam will be necessary to meet the increased production cost. Company B thinks 20c will be sufficient. Company D sells its heat on a flat rate basis and has not arrived at a decision. Company G estimates that the rates should be increased 25 cents.

A typical example of the revision of the heating schedules is furnished by Company A as follows:

Old Schedule.

	Per 1,000 Lbs.
First 10,000 lbs. steam per month	$1.00
Next 10,000 lbs. steam per month	0.90
Next 10,000 lbs. steam per month	0.80
Next 20,000 lbs. steam per month	0.70
Next 40,000 lbs. steam per month	0.60
Next 250,000 lbs. steam per month	0.50
All over 340,000 lbs. steam per month	0.40

New Schedule.

	Per 1,000 Lbs.
First 10,000 lbs. steam per month	$1.50
Next 10,000 lbs. steam per month	1.25
Next 20,000 lbs. steam per month	1.00
Next 40,000 lbs. steam per month	0.75
Next 920,000 lbs. steam per month	0.60
All over 1,000,000 lbs. steam per month	0.55

In the case of Company B the increase takes the form of a schedule which is about 20% higher than the old schedule. The old schedule of rates for general business was:

$1.50 per 1,000 lbs. for the consumption up to and including 10,000 lbs. in any month.

$1.00 per 1,000 lbs. for the excess consumption in such month over 10,000 and up to and including 20,000 lbs.

$0.80 per 1,000 lbs. for the excess consumption in such month over 20,000 and up to and including 30,000 lbs.

$0.70 per 1,000 lbs. for the excess consumption in such month over 30,000 and up to and including 80,000 lbs.

$0.60 per 1,000 lbs. for the excess consumption in such month over 80,000 and up to and including 200,000 lbs.

$0.55 per 1,000 lbs. for the excess consumption in such month over 200,000 and up to and including 400,000 lbs.

$0.50 per 1,000 lbs. for all excess consumption over 400,000 lbs.

The new schedule is as follows:

$2.00 per 1,000 lbs. for the consumption up to and including 10,000 lbs. in any month.

$1.30 per 1,000 lbs. for the excess consumption in such month over 10,000 and up to and including 20,000 lbs.

$1.00 per 1,000 lbs. for the excess consumption in such month over 20,000 and up to and including 40,000 lbs.

$0.80 per 1,000 lbs. for the excess consumption in such month over 40,000 and up to and including 100,000 lbs.

$0.70 per 1,000 lbs. for the excess consumption in such month over 100,000 and up to and including 300,000 lbs.

$0.60 per 1,000 lbs. for all excess consumption in such month over 300,000 pounds.

Both schedules are subject to a discount of 10% for prompt payment.

Company C states that its old schedule is as follows:

$1.50 per 1,000 lbs. for the condensation registered in each month up to and including 4,000 lbs.

$0.50 per 1,000 lbs. for the excess condensation registered in such month over 4,000 lbs. and up to and including 104,000 lbs.

$0.45 per 1,000 lbs. for the excess condensation registered in such month over 104,000 lbs. and up to and including 304,000 lbs.

$0.40 per 1,000 lbs. for the excess condensation registered in such month over 304,000 lbs.

The above rates are subject to a discount of 10% if bills are paid at the company's office within ten days after their date. Minimum bill, $40.00 net per customer per season.

Company E states that it has in mind petitioning for a surcharge to be added to each bill rendered. Its present schedule for hot water heating is at the rate of 20c per square foot of required radiation. The flat rate for steam heat is 25c per square foot of required radiation and the meter rate on steam heat averages 46c per 1,000 lbs. for the first 100,000 lbs. condensation and 35c per 1,000 lbs. for all condensation used over and above the 100,000 lbs.

Comparative schedules are submitted by Company G as follows:

Old Schedule.

First 5,000 lbs. condensation, per month, $0.70 per 1,000 lbs.

Next 5,000 lbs. condensation, per month, $0.65 per 1,000 lbs.

All over 10,000 lbs. condensation, per month, $0.50 per 1,000 lbs.

Less 10% discount.

New Schedule.

First 50,000 lbs. condensation per month, $1.00 per 1,000 lbs.

Next 50,000 lbs. condensation per month, $0.90 per 1,000 lbs.

Next 100,000 lbs. condensation per month, $0.80 per 1,000 lbs.

Next 200,000 lbs. condensation per month, $0.75 per 1,000 lbs.

Next 400,000 lbs. condensation per month, $0.70 per 1,000 lbs.

All in excess of 800,000 lbs. condensation per month, $0.60 per 1,000 lbs.

Less 5% discount.

Company E sent in the following tabulation showing the percentage of increase of prevailing prices over normal prices, in operating expenses, computed from the reports of a large number of utilities:

	Per Cent of Increase over Normal Prices
Coal	194
Labor	33
Miscellaneous Supplies	66
Taxes	48
Equipment	51
General Operating	46

N. D. H. A. Notes.

R. D. DeWolf, of the Rochester Railway & Light Co., a former president of the National District Heating Association, is on war service with the naval forces, in which he holds the commission of lieutenant.

Fred B. Orr, of the Illinois Maintenance Co., Chicago, is also a lieutenant in the naval forces and is on active service on the Atlantic.

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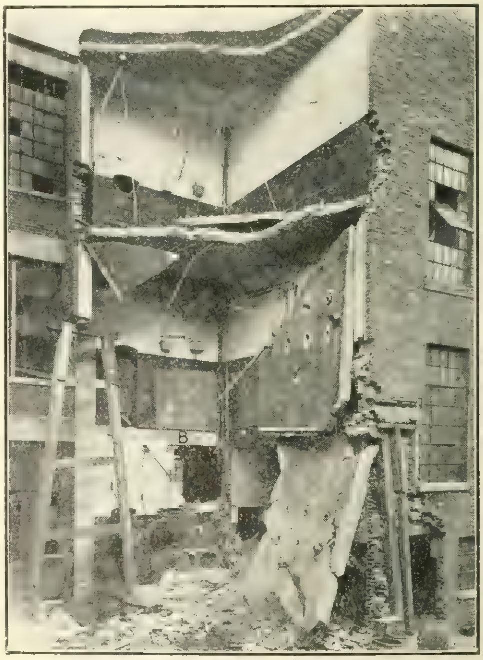
Explosions of Hot Water Heaters And Storage Tanks.

By Heating Engineer

Occasionally one's attention is drawn to explosions of hot water heaters of different kinds. But such explosions have invariably been proved to be the result of frozen pipes, or a hermetically sealed system, combined with the powerful force of expansion due to the application of heat when the system was so sealed.

Such accidents are easily explained. Suppose, for instance, the weather is severely cold. The fire in a hot water heating system has been neglected. The water cools down during the night, and the expansion pipe between heater and expansion tank becomes frozen. The attendant pushes up the fire in the morning, ignorant of the fact that the expansion pipe is frozen. Then an explosion of the heater may, or may not, occur. This is what happens.

The water being heated expands within the system, which is composed of heater,



Courtesy of Power, N. Y.

FIG. 1—RESULTS OF HOT WATER TANK EXPLOSION IN WORKS OF HUDSON MOTOR CAR COMPANY, DETROIT.

piping, and radiators. If there is no air in the system, every part being completely filled with water, then the force of expansion is immediately directed upon every square inch of its internal surface. This force is so great that the metal comprising the heating system cannot resist it. And it is felt by the system long before the water reaches its boiling point. Such a system can be burst while the water is only lukewarm, and the burst will not be in the form of an explosion. It will just split the weakest casting, and the water resulting from the expansion will ooze out slowly as the water heats. And should the water cool again before the frozen expansion pipe is thawed out, the shrinking of the water due to cooling will suck air in through the crack.

RESULTS WHEN SYSTEM IS AIR-TRAPPED.

But how different it is when there are air pockets in the system. The trapped air becomes compressed by the expansion of the water, the pressure increasing as the air is compressed. In reality the system is then the same as a closed expansion-tank system, but without a relief valve. It is like a steam boiler without a safety valve. If the water expansion, during heating up to the boiling point, does not increase the pressure sufficient to burst the system, heat becomes stored in the water until steam is produced. Then the pressure rises materially. Ultimately it exceeds the resisting power of the weakest part of the system. If a radiator is the weakest part, it gives way; then a blow-out, causing water and steam damage in the building, may be expected. But if the heater is the weakest part, and if it ruptures, not in a small blow hole, but in the separation of a section, then a real explosion will be the result.

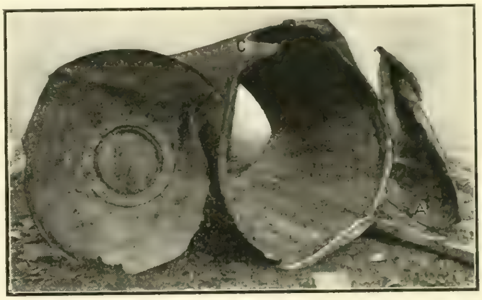
The energy stored in the highly-heated enclosed water will spend itself on its sursoundings. If the rupture is such that the energy is spent instantly, as in the separation of a heater, the explosion will be violent. If it is such that the expenditure of energy is distributed throughout a considerable period of time—say a minute, as by a broken radiator section—the rupture is not called an explosion but just a blow-out or burst.

A similar thing applies to powder. Take a pound of powder in a tin can and touch it off. An explosion is the result because its energy is spent instantly. But run it out along the ground in the form of a train, and touch off one end. There will be no explosion, for the force of the powder is not all exerted at the same instant.

But it is an exceedingly unusual occurrence for a hot water storage tank, heated by a thermostatically-controlled steam coil, to explode violently. If hermetically sealed it might rupture and leak by the force of water expansion, but this is not likely by actual steam expansion.

A peculiar accident of this kind is reported to have occurred recently, a notice of which appeared in *Power* as follows:

"The illustrations show the results of a hot-water-tank failure which occurred at the works of the Hudson Motor Car Co., Detroit, at 4:17 a. m. on Mar. 26. The tank was 45-in. diameter by 72-in. long and was suspended from the ceiling of the first floor of a three-story brick building with reinforced-concrete floors. The shell was made from 3/16-in. steel with heads of 5/32--in. steel, and all the seams were welded by the oxyacetylene process, but were apparently done in a poor manner. Vessels used for this purpose do not come under any regulations in Detroit.



Courtesy of Power, N. Y.

FIG. 2—REMAINS OF HOT WATER TANK.

"In Fig. 2 the head marked A in the illustration seems to have failed from sheer fatigue in the welding. The dish of the head could not be ascertained, but was said to be about 3 in. This tank had a closed coil of pipe for the purpose of heating the water contained in it and furnished water to the lavatories. It had a temperature regulator and was supplied directly with water from the mains, the pressure in the mains never exceeding 35 lb. A large number of the bib-cocks in the lavatories were constantly leaking, so that it was rather difficult to believe that any elevation of pressure could occur in this tank, although the supply pipe was fitted with a check valve. It is doubtful if the temperature of the water in the tank greatly exceeded that corresponding to the pressure in the mains, which would be from 260 to 270 deg. The tank was also fitted with a relief valve, which was found to be operative after the accident.

"It will be seen from the crumpled end of the tank that it was projected with considerable force against the 12-in. brick wall at B, Fig. 1, where it tore a hole through the wall and struck a 60-in. flywheel, wrecking it, and at the same time tearing the tank C, Fig. 2. After wrecking the wheel there was sufficient energy in the tank to wreck an 8-in. tile wall which surrounded the compressor room. The wrecked wing of the building was in a court or passageway about 30 ft. wide between buildings. At the initial failure some windows directly opposite the tank were pushed in, but after the equalization of pressure, windows higher up were drawn out and broken."

Power has given a very definite description of the facts as they appeared, but it would be interesting to know the steam pressure carried in the coil and the temperature of the tank water at the time of the explosion. Such data, however, are usually unobtainable in cases of this kind.

We are inclined to believe that the welding was defective, but cannot understand how both ends should be blown out. If one end is blown out of a cylinder, the cylinder may be projected through space like a rocket, but when both ends are blown out, then it would appear that the ends would fly through space while the cylinder stayed in place.

And then when we consider the fact that several factories recently have been afflicted with incendiary bombs—does it not appear from the great damage done to the building that some miscreant may have caused an explosion near the tank which wrecked the building, and started the tank seams, thereby allowing the internal pressure to break loose and complete the tank's destruction?

A bomb explosion great enough to blow out the walls of the building might be powerful enough to drive the tank through the wall and destroy it, as described. The writer would value the opinions of some of the practical readers of The Heating and Ventilating Magazine on this matter.

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The Process of "Spellerizing" as Applied to Pipe.

The form and chemical composition of matter are well-known to be distinct properties. For example: Fig. 1 represents carbon in the form of coke; Fig. 2 represents the same material in the form of a diamond. The diamond, due to the tremendous pressure to which it has been subjected, is practically pure carbon bearing no outward resemblance to carbon in the form of coke, coal or charcoal. Metals undergo changes almost as remarkable if subjected while hot to certain heat treatment and mechanical manipulations.

Commercially pure iron is produced in several forms; puddled iron, knobbled charcoal iron, so-called ingot iron and soft welding steel have much the same chemical composition as commercial products but may differ considerably in physical properties and durability according to the treatment given in process of manufacture.

Uniformity, both as to chemical composition, density and character of structure and finish have been demonstrated to be the most important factors governing corrosion in pipe. The actual chemical composition of the iron or steel has been demonstrated to be of comparatively little importance provided it is not unduly variable in the same piece.

In so far as pipe is concerned, with which this article is particularly concerned, thorough investigation and research have shown that the greatest danger from corrosion occurs to the smaller sizes of pipe, owing to the thinner walls. The larger sizes with thick walls are made from heavy plates of such uniform quality that corrosion does not seriously affect them to any appreciable extent.

Fig. 1—Carbon in Form of Coke.

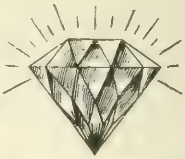

Fig. 2—Carbon in Form of Diamond.

To overcome the tendency to corrosion in the smaller sizes a process has been evolved, known as "Spellerizing." This is technically defined as follows:

"Spellerizing is a process of treating metal which consists in subjecting the heated bloom to the action of rolls having regularly-shaped projections in their working surfaces, then subjecting the bloom while still hot to the action of smooth-faced rolls and repeating the operation, whereby the surface of the metal is worked so as to produce a uniformly dense texture better adapted to resist corrosion, especially in the form of pitting." Inasmuch as this process is entirely mechanical and does not in any way depend upon skilled labor, beyond keeping up the machinery involved, uniform treatment is assured.

The Spellerizing process is applicable to the smaller sizes of pipe—say, 4 in. and under—although it is possible in special cases to Spellerize pipe a few sizes larger.

As a matter of homely fact, the process

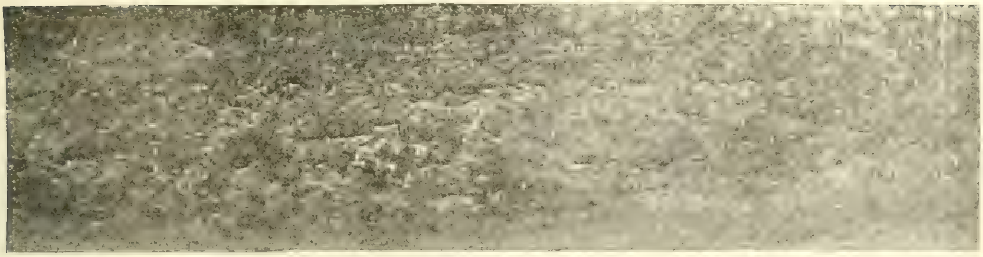

Fig. 3—Sample Wrought Iron Pipe immersed in running mine water in West Pennsylvania Coal Mine. Comparative loss by corrosion—Wrought Iron, 100%; Spellerized Steel Pipe, 73%.

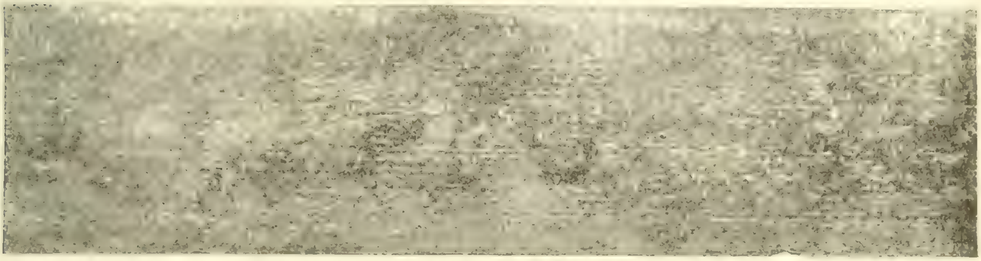

Fig. 4—Sample Spellerized Mild Steel Pipe immersed in running mine water in West Pennsylvania Coal Mine, side by side with Fig. 3.

of Spellerizing metal may be considered analogous to the kneading of dough from which bread is made. Dough is kneaded to produce a smooth, uniform texture; to facilitate the escape of confined gases, which would form air holes and other irregularities in substance and on surface, and to make an even grain and fine, smooth surface. Much the same results are obtained by Spellerizing steel.

There are other factors such as contact with other materials which are electronegative to iron, such as carbon or oxide of iron, or electrolysis due to stray currents which will cause local failures no matter how carefully the steel is made.

Pipe has been made by this process for ten years in increasing amounts. It is significant to note that official records of the American Iron and Steel Institute show that during this period steel tubes and pipe have increased from 74.3% of the total production in 1906 to 87.9% in 1916.

New Spellerizing steel pipe and new wrought-iron pipe considered best by master mechanic of large Western Pennsylvania coal mine were submerged in running mine water side by side, but insulated from each other. Figs. 3 and 4 show the uniform corrosion of specially-worked pipe steel as compared with irregular corrosion and pitting of wrought-iron pipe.

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American Public Health Association will hold its annual meeting in Washington, D. C., October 17-20, 1917.

Reminiscences of an Engineer.

BY WILLIAM J. BALDWIN.*

My first acquaintance with steam apparatus was in 1854 when a 2-in. elbow and nipple from an exploded boiler, at the sectional dry dock in East Boston, came through the school house window. We investigated the occurrence, that is, the teacher and I, and ever since that time I have felt that I am able to qualify as an expert in 2-in. fittings.

My father was a British naval architect and I was desirous of being a naval architect, being of a race of sailors on both sides. Such was my youthful ambition, either to be a ship builder or a ship master and Boston was a good place, in those days, to acquire a knowledge of ship building. I will say that I commenced to study shipbuilding when I was 10 years old by spending my Wednesday and Saturday afternoons in the ship yards of East Boston and my Sunday afternoons on the Grand Junction Wharf, in East Boston.

Here the great clipper ships of those days fitted and refitted, such as the Dauntless, the Flying Cloud, the Sovereign of the Seas, the Red Jacket and the Blue Jacket, the Donald McKay and the famous Great Republic, the latter being the first four-masted ship ever built and the largest in her day. She was launched in the Fall of 1854 from the yard of Donald McKay, who was the greatest sailing ship builder the word has ever produced and was known as the "Prince of Shipbuilders."

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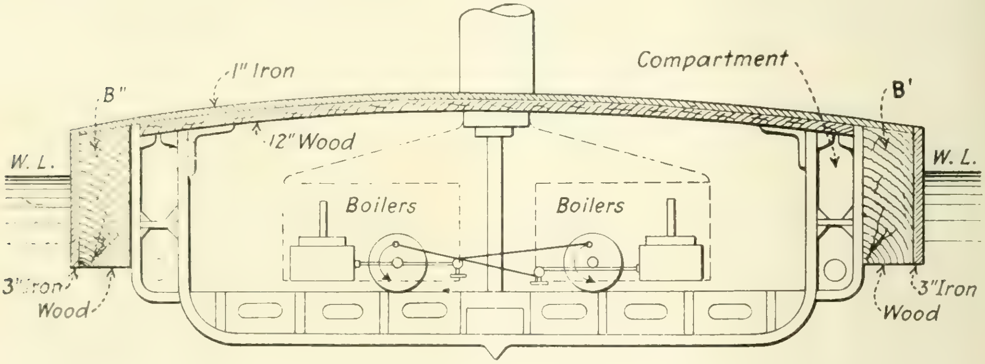
*Mr. Baldwin has the distinction of being known as the dean of the heating profession in the United States. As the author of a number of works on heating and ventilation, including "Baldwin on Heating," which ran through fifteen editions, he has provided many of the leading engineers of to-day with the basis of their training. He is an honorary member of The American Society of Heating and Ventilating Engineers.

Tetlone, Curtis and McKay, all great shipbuilders and famous, had ship yards in the third section of East Boston, just across the river from the Charleston Navy Yard. This was the atmosphere in which the boy acquired his love for ships. From the slope of the hill, just below the reservoir, I watched the launching of many famous clipper ships, and it was from this eyrie that I also saw the launching of the famous ram, the Merrimac, about 1856. She was then known as the beautiful U. S. Sloop-of-War Merrimac, built at the Charleston Navy Yard, almost at the foot of the Warren Monument, and within sight of Bunker Hill.



CROSS-SECTION OF THE "MERRIMAC" TYPE OF RAM OF CIVIL WAR DAYS.

The Merrimac was a beautifully-modeled full-rigged ship, with auxiliary steam propulsion; that is, she could draw her propeller out of the water into her sternwell and could then be operated as a sailing ship. There were several like her, all beauties in model, but unable to carry their armament of twelve big guns when in a sea-way. To distinguish a sloop-of-war from a frigate, the former has her guns on the main deck and, in this case, the guns were too heavy for the ship. The metacenter was too high with the guns on board.

This circumstance explains why the Merrimac was at the Norfolk Navy Yard when the Civil War broke out. The commandant ordered her destroyed but, unfortunately, some one opened the sea cocks, as well as setting her on fire. So she sank and extinguished the fire and was saved to the Southerners who raised her and made her into an "ironclad."

The famous engagement of the Merrimac and the Monitor is too well-known to call for special comment. Speaking of the monitor type of vessel, however, I had the honor of helping to construct three monitors in the yard of Donald McKay, the Casco, Squando and Naussett. The Nahant, which lay in the Narrows in the harbor of New York, during the Spanish-American war, was a vessel of this type.

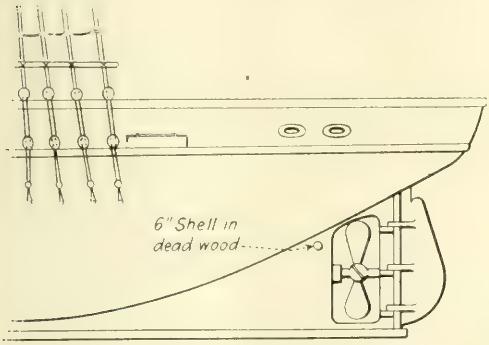
When the Civil War was in its first year, I was a draftsman and apprentice with Donald McKay. Eben Hodge, James Hodge and James Gardner were his engineers when he turned from wooden ship building to making and repairing and altering war ships for the United States government.

In this school I received my training up to the time of the close of the war. The drafting room was too quiet for me. I James Hodge, the superintendent, to give wanted to make something and I asked me a job on the outside. He hesitated at first on account of what he considered my frailness, but he changed his mind afterward and I was the last man in the employ of Donald McKay, in the yard, when the war ended.

Perhaps one of the most interesting experiences that fell to my lot, while in the yard, was the altering of the blockade runners into United States cruisers. These beautiful steel blockade runners, built by Laird and others in England, would be captured and sent in, and it was our duty to make cruisers of them in the shortest time possible, say two months.

Their rails were taken off and the stanchions pieced out until there was a space of from 7 to 8 ft. in the clear, "'tween decks," that is, between the old main deck (all they had originally) and the upper deck which we put on. This made room for officers' quarters and armament on the main deck and gave ample room for fuel, storage, crews' quarters and magazines below, with roomy, ample and airy quarters on the main deck, while the upper deck was left free for working the ship.

These beautiful models were made of light draft for navigating the waters of the Bahama Islands and Bermuda and our own shallow, southern coast, and so that they might run in through back-ways and by-ways or creeks and land their sulphur, saltpeter, guns and munitions so much required by the South, and get out with a cargo of cotton, piled until their decks were awash.



LOCATION OF 6-IN. PERCUSSION SHELL IN STERN POST OF U.S.S. KEARSARGE.

They carried coke for firing on our coast so as to show little or no smoke, but the peculiar noise made by their feathering paddles was enough to locate them in fine weather. In 1866 I found these vessels in South America as coasting liners. They were good sea boats and many of them were used by Brazil as transports during the Paraguayan War.

An incident of which I was a witness, connected with the closing of the Civil War, was the taking of a 6-in. percussion shell from the stern-post of the U. S. S. Kearsage after her battle with the Alabama, in which she sank the latter. It is a conical, fluted 6-in. shell and is now in the Smithsonian Institute in Washington, but its charge has been withdrawn. A circle of deep auger holes was bored around it and it was withdrawn in its matrix of wood. Had the matrix been preserved, as well as the shell, it would have better preserved the story of the immortal Winslow and the close call of the Kearsage in that memorable fight off the French coast.

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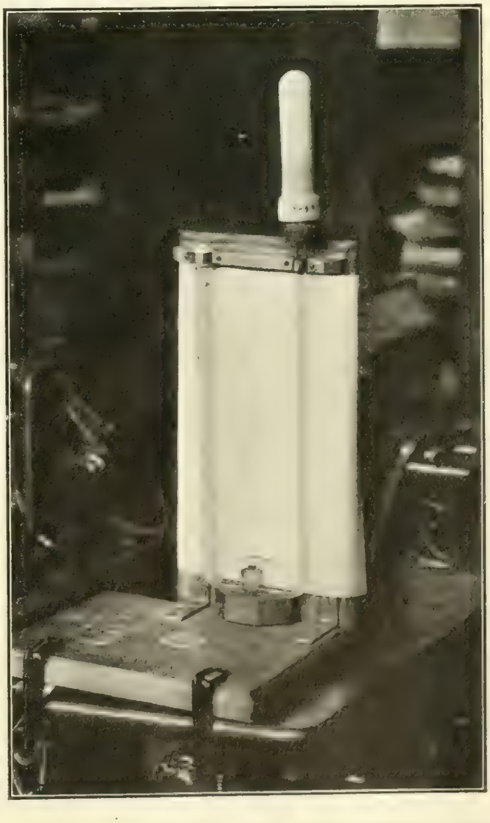
New Air Measuring Instruments.

So much interest has been aroused by the mention of the new air measuring instruments, in the report published last March of George T. Palmer's address before the New York Chapter of the heating engineers' society, that we present herewith a more detailed description of these devices.

THE ATMOMETER, AN INSTRUMENT FOR MEASURING THE DRYING POWER OF THE ATMOSPHERE.

This device consists of a finger-shaped porous cup, about 5 in. long, attached to a glass U-tube, one arm of which is graduated in tenths of a cubic centimeter. The apparatus is set up by filling the cup with distilled water, to which a trace of copper sulphate has been added, to prevent the growth of moulds and small plant life. The capillary arm of the U-tube is then inserted in the cup, the arm being filled with water up to the stop cock. These parts are held together by the rubber stopper which makes a water-tight joint.

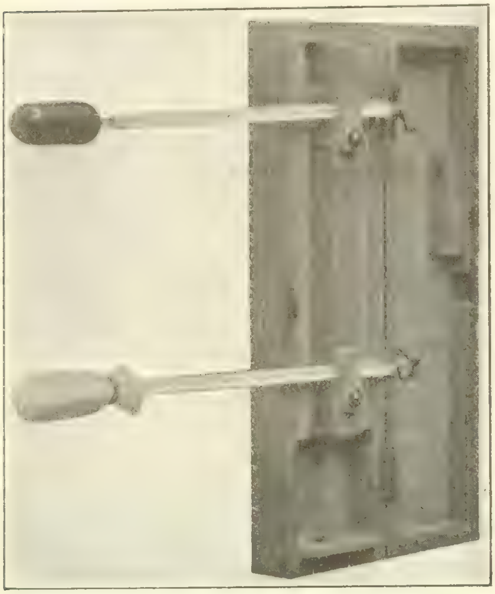
The instrument is now inverted with the porous cup uppermost, the graduated arm



THE ATMOMETER, FOR MEASURING THE DRYING POWER OF THE ATMOSPHERE.

of the U-tube filled with water and, on making sure that no air bubbles have been caught, the instrument is ready for use. Ample time should be given for the water to make its way through the porous cup before observations are taken.

As water evaporates from the surface of the porous cup, more water is drawn up through the capillary arm to take its place. The amount evaporated in a given time is read off directly from the water level in the graduated arm.



THE KATA-THERMOMETER

For Measuring the Combined Effect of the Three Methods by which Air Extracts Heat from a Hot Object—Radiation, Convection and Evaporation.

This instrument is useful in measuring the relative drying effects of air at various temperatures, humidities and rates of air movement. It should be borne in mind that the absolute quantity of water evaporated is, of course, dependent on the size, shape and material of the porous cup and of its temperature.

Each cup is standardized by the makers against a cup in their possession and the product of the amount of water evaporated from any cup and its coefficient gives results comparable for all cups. This cup has been used by horticulturists in studying the effect of dryness and moisture on plant growth and its use is described in a paper entitled, "Atmometry and the Porous Cup Atmometer," by B. E. Livingston. This paper and the cup may be secured from *The Plant World,* Tucson, Arizona. The particular U-tube connection shown in the photograph was devised by the New York State Commission on Ventilation and is used in studying dryness as related to ventilation.

THE KATA-THERMOMETER.

This instrument measures the combined effect of the three methods by which air extracts heat from a hot object—radiation, convection and evaporation. It consists of two glass bulbs, shaped as in the photograph, and filled with a colored spirit. The necks of the bulb are graduated in degrees Fahrenheit from 95 to 100. The bulbs are placed in hot water until the spirit column rises well above the 100° mark. The bulb without the cloth covering is then dried and either placed in the rack provided or suspended in the air on a string. The bulb with the cloth covering is gently shaken to remove excess water and then exposed similarly to the dry bulb.

Both bulbs lose heat to the surrounding air and their rate of losing heat is measured by timing the spirit column in its fall from 100° to 95° F. Each bulb possesses a coefficient which is divided by the time of fall in seconds and the quotients thus obtained, when added together, express the heat-extractive power of the air in terms of calories per square centimeter per second.

The kata-thermometer is useful in measuring the deheating effect of the atmosphere during the time the reading is being made. It is not possible with this instrument, however, to follow the slight fluctuations in deheating effect which are constantly occurring. Prof. Phelps, of the New York State Commission on Ventilation, has attempted to meet this situation with a wet-bulb thermometer to which a constant amount of heat is supplied through an electrically-heated coil. If the heat production is constant then any change in the rate of heat loss must show itself in the actual temperature of the instrument. If the air temperature and relative humidity are high and the air movement is slight, the rate of heat loss from the heated bulb will be slow and, inasmuch as the amount of heat supplied does not change, the mercury column on the thermometer will rise up to a point where its rate of heat supply and heat loss is balanced. Heat is thus being stored up in the instrument.

In a cold atmosphere heat is taken away from the bulb about as quickly as received and the mercury column does not get an opportunity to rise. The fluctuations in rate of heat loss may then be determined by reading the mercury column at intervals or by fitting up a bulb on a recording psychrometer and thus obtaining a continuous inked record of the heat loss changes.

This type of instrument has been named the "Comfortmeter" as it measures, in a way, the degree of comfort which air produces. It is the rate of heat loss from all causes that determines body comfort and this instrument as does the kata-thermometer, measures not merely the temperature of the air alone, not merely its relative humidity, not merely the velocity and constancy of air movement, but the combined effect of all three.

Two forms of the "Comfortmeter" have been used by the Ventilation Commission in its work. This instrument, however, is in an early stage of development and any further details of construction are without special interest at this time. The significance of the readings and the form of scales used must also await further experience for interpretation. The kata-thermometer was designed by Dr. Leonard Hill, of London. It is manufactured and sold in this country by the Fiebe-Gorman Co., Monadnock Block, Chicago, Ill.

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Publicity for the Heating Engineer.

Under the title of "Simple Plan for Dehydrating Food is Discovered by Engineer," the New York Globe, in its issue of July 26, featured the drying session of The American Society of Heating and Ventilating Engineers, at its recent meeting in Chicago, lays special emphasis on the suggestion made by Walter L. Fleisher, of New York, at that meeting, that the heating and ventilating plants in public school buildings be utilized, during the summer months, for drying fruits and vegetables. The article is written by Alfred W. McCann, the well-known food expert.

The article, in part, is as follows:

Walter L. Fleisher, a "heating and ventilating engineer" of New York City, is the father of an idea which promises, if acted upon by the fathers of the government at Washington and the various state and city fathers who dwell in every voting centre of the United States, to revolutionize the canned food industry.

Walter Fleisher is a member of The American Society of Heating and Ventilating Engineers. It was at a meeting of this Association at the La Salle Hotel, Chicago, recently that he justified his existence for all time by proposing an idea so simple, and yet so rich in possibilities, that it promises to upset all the existing notions on the subject.

Fleisher for three or four months has been doing experimental work in dehydration for the Westchester Association, now operating some dehydrators at White Plains, the mayor's committee and the Department of Agriculture. Like all other engineers honestly interested in their work, he has found that there is really nothing new either in the methods or in the products, and has said it so bluntly and sincerely.

"The main trouble with the whole proposition," said Fleisher to his fellow engineers, "has been that we have never attempted to use the apparatus and plants already at hand. We have always been balked by the objection of cost. The thing is too expensive to be practicable, say any number of interested people.

"Yet the facts are that the things needed for a successful dehydrating plant are a large blower or fan, a steam radiator or heater to warm the air, a boiler for generating heat for the radiator, a sheet-iron tube to carry the heated air to the drier, and a method of regulating temperature, either by hand or with a thermostat.

"In every modern school building in America as well as in every modern public building, there is a modern heating and ventilating apparatus. Municipal buildings, state buildings, federal buildings, have been erected with these modern heating and ventilating plants all over the country.

"In every one of these institutions is tucked away an ideal dehydrating plant which is never used. Many of these buildings are practically shut tight during the very months of the year in which our perishable foods are marketed. I propose that in every school conveniently located, as well as in every state or federal building of the same character, in which a modern heating and ventilating plant is now installed, some room near the source of supply of heat ought to be turned into a dehydration.

"This can be done with very small expense, and the heat, thermostatically controlled, can be brought from the fan to this drying room, and there applied for the proper dehydration of any of the fruits or vegetables which the community might have for preservation."

Mr. Fleisher stated that he would be not only willing to take any school building in New York City and design the necessary changes that would convert one of its rooms into a community dehydrating plant, but that he would enthusiastically embrace the opportunity.

CORRESPONDENCE

The Development of Temperature-Controlling Apparatus.

Editor Heating and Ventilating Magazine:

Large buildings under construction are now, as a rule, equipped with an automatic heat-regulating system, such as the Johnson or Powers method of compressed-air control. In old buildings, however, these compressed-air systems are rarely installed, because of the cost and inconvenience which would result from the tearing up of floors and plaster in order to lay the air pipes. Thus, the heat in these buildings is allowed to run wild, to the great discomfort of the occupants.

Can you tell me why it is that a suitable electric system of heat control has not been developed to meet this demand? I have made considerable investigation to ascertain why an electric system has not been developed and have come to the conclusion that the difficulty lies in obtaining a suitable electric valve which will perform the same functions as the rubber or metal diaphragm in the compressed-air system. Can you advise me as to the correctness of my conclusion?

In an electric system, a single transformer could furnish sufficient low-voltage current from the 110-volt lighting circuit to supply the entire building. The current could be carried around the main walls by a single small pipe or conduit, over the molding in the hall, and the voltage and current could be made sufficiently low to enable the leads from the main conduit to the rooms to be laid bare and still not violate the rules of the electric code. Thus no tearing up of floors or plaster would be necessary.

There is also a big demand for an electric system in large apartment buildings. The hot water or steam piping could be so arranged that a single valve, controlled by a single thermostat within each apartment, would control the heat of that apartment. Also the radiation surface of the radiators in the most exposed apartment of the building could be made a little smaller than those of the other apartments so that if the exposed apartment obtains enough heat, the other apartments would also. A second thermostat in the exposed apartment would control the drafts of the furnace, in conjunction with the safety valves of the furnace, thus making the entire building automatically controlled.

L. R.

Our correspondent is quite correct in saying that there is a good field for automatic control in buildings already erected, and yet this field is not as large as might readily be supposed. There has never been any argument made against the desirability of automatic control of all heating devices and systems, no matter where placed or how operated, but to develop such control so as to be economical to install, positive in action and dependable at all times has not been so easy.

There is, however, a method of electrical control which has been developed by the Gold Car Heating & Lighting Co., of New York City, for use on car heating apparatus where the steam pressures run anywhere up to 100 lbs. The fact that this apparatus gives satisfactory operation under such pressures and when constantly subjected to the jolting of the car indicates its practicability. This system utilizes direct electric current, usually at 110 volts and consumes between 5 and 10 watts of current, according to the steam pressure. A similar apparatus to work on alternating current has not yet been perfected and, therefore, the voltage could not be handled by a transformer, as suggested, as a transformer will supply only A. C. current. Neither could sufficient force be obtained to operate the steam valves economically unless a voltage much higher than that suggested by our correspondent be used. In other words Underwriters' rules would have to be followed in the installation of wiring.

The electric thermostat for this system is simply a switch operating the magnet valve which consists of a solenoid which, when energized, forces the valve stem down and closes the valve. When de-energized a spring raises and holds the valve open the same as in the ordinary pneumatic system.

The original Johnson system was also electrical in so far as the thermostat was concerned, this controlling a pneumatic valve on the air line by means of a swinging armature which was turned by the energizing of adjacent magnets so as to throw the air on and off the pneumatic line. These thermostats operated such small valves that it was possible to use a current from a series of bell batteries but the danger of running out these batteries by an accidental short circuit, the constant wearing out of the batteries from excessive operation during cold weather (thus throwing the control of the whole building out) and the trouble experienced when these batteries were neglected led to the abandonment of this system.

Another control manufacturer who does not yet make such an electrical control states that it would be entirely feasible to develop such a system and believes that in the end it will be simpler and less troublesome than the compressed air lines but adds that no one to his knowledge has commercially developed such a system which is an *entire* success. He also states that large thermostatic control installations are almost invariably made for direct electric current which it is impossible to handle from a transformer and that it would probably necessitate the use of a motor generator.

It must be remembered that in buildings erected outside of schools, office buildings and others of a public nature the architect, builder, speculator or other individual most intimately concerned is possessed of a strong desire to make a showing with a low first cost and that for this reason automatic control has been, and will continue to be, omitted from a great many buildings where its use would be most beneficial, and where its installation would undoubtedly show a considerable saving on the operating end.

Condensation in Engine Cylinders and Its Bearing on Exhaust Steam Heating.

Editor Heating and Ventilating Magazine:

In The Heating and Ventilating Magazine for May, (page 53), you published a reply to some questions in regard to heating by exhaust steam. At the end of this reply (bottom of first column, page 54), you give an analysis of the amount of heat subtracted from the steam in the process of passing through the steam engine.

I would respectfully call your attention to the fact that your analysis is incorrect in that you have neglected the fact that part of the heat converted into work in a steam engine is supplied by actual condensation of the steam, so that, under ordinary conditions, the exhaust steam which leaves the engine is not dry steam, but contains a certain amount of moisture. That this is true can be easily proved from your own figures. For instance, according to these figures, each pound of steam gives up 38 B. T. U. Since the engine is rated at 40 lbs. of steam per H. P. hour, this gives 1520 B. T. U. per H. P. hour furnished by the steam. Since one H. P. hour is equivalent to 2545 B. T. U., this would give the engine a mechanical efficiency of something like 170%. The answer is, of course, as stated above, that not all of the heat necessary for producing work in the engine cylinder comes from the reduction in pressure of the steam, but part of it comes from actual condensation of the steam itself.

Hartford, Conn. B.

Our correspondent is quite correct, but he will note that we stated:

"On account of small losses in the engine and the possibility of slightly higher condensing ability in some parts of the system we could not recommend over 95% of the above, say 11,400 sq. ft. for cast-iron surface, or 9,500 sq. ft. for pipe coil surface."

The small losses referred to mean the condensation and radiation losses occuring in the cylinder. We were also careful to say "*about* 4,000 lbs. of steam would be available" as the pounds of exhaust could not *quite* equal the pounds of steam supplied. Actual experiment has proved that only 4% more steam is required to operate an engine, than to pass it through a reducing valve and not operate the engine, both producing thermally the same heating effect after their passage. Therefore, a thermal efficiency of 96.8 seems pretty nearly correct, for on this basis if it took 100 lbs. of steam at high pressure to do a certain heating work it would take 104 lbs. supplied to an engine to do the same heating work after passing through the engine. In the case in question, with the steam passing through the engine, say it takes 104 lbs. Then, if our thermal efficiency figure is correct, 104 × 96.8% thermal efficiency must equal the actual heating effect of the exhaust; in reality it does equal 100.672 lbs. or about as close as theoretical figures can be made to check with actual experiments.

Our correspondent has raised a most interesting question, however, regarding the B. T. U. utilized in the engine and the matter of condensation in the engine cylinder. While space limitations will not allow us to undertake a detailed discussion of engine cylinder losses we would refer our reader to a paper by David Moffatt Meyers read before The American Society of Heating and Ventilating Engineers in 1915 on the "Heating Value of Exhaust Steam." In this discussion a chart was shown covering the maximum and minimum percentage of B. T. U. *contained in the initial steam supply* to the engine *which are also present in the exhaust.* According to this chart an engine using 40 lbs. of steam per 1 H. P. would have about 94.4% to 93.8% (of the original B. T. U.) contained in the exhaust steam and ready for use in the heating system. Mr. Meyers goes on to say "It is, perhaps, hardly necessary to state that the results in the use of exhaust steam in actual practice closely agree with these determinations of heating value. Any engineer who has had the opportunity to make observations with actual measurements, has found that exhaust steam from a simple engine is worth, for heating purposes, nearly as much as live steam. I have myself been fortunate in having had opportunities for this kind of measurement. I might mention one case where several slide valve engines were used to furnish power whose exhaust steam was absorbed by the heating system in a large manufacturing concern. The exhaust steam just balanced the heating requirements at the time of year when I made my experiment. I shut down all the engines in the plant and supplied the heating system by using the live steam at reduced pressure. The fuel was carefully weighed and it was found that just as much was consumed during the test with the engines shut down as when all the engines were developing their full quota of power. . . . I have made other tests which have checked up these results closely."

Of course, the point of cut-off has much to do with the condensation attained in the cylinder, which is only another way of saying an efficient engine makes a thermally inefficient exhaust. The longer the cut-off the less the condensation, as may be seen from steam pumps which consume only about 1% of the B. T. U. supplied, leaving their exhaust *with* a thermal efficiency of 99%.

Considering the fact that many engineers advocate the use of engine exhaust steam in preference to live steam and that authentic instances are known where the installation of engines has actually *reduced* the coal bills *and perforce the pounds of steam produced* we believe our reply checks very closely with the results which would be actually attained. Of course the question as originally submitted was more or less academic and hypothetical, it being impossible to exhaust an engine into a heating system at atmospheric pressure—usually 3 to 10 lbs. of back pressure must be carried in such cases. It is a question, however, whether the full 4,000 lbs. of steam could not really be considered in view of the practically equal efficiency of exhaust steam found in actual practice.

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Leon H. Prentice, president of the L. H. Prentice Co., Chicago, Ill., has the sympathy of his friends in the death of his wife which occurred July 30, at their home in Waukegan. It is thought her death was hastened by the drowning of her son, Hamill, about a year ago.

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The New York School of Heating and Ventilating announces the opening of the fifth annual season for 1917-1918, on Monday and Wednesday evenings, commencing October 1, in Room 512, World Building, New York. Charles A. Fuller will direct the classes. The secretary is G. G. Schmidt, World Building, New York. The fee for each course (first year and second year) is $15.00.

LEGAL DECISIONS

"Accident" Under Workmen's Compensation Act.

Action was brought for compensation under the Nebraska Workmen's Compensation Act by a steam fitter's helper employed by a corporation engaged in the heating and plumbing business. The plaintiff's duty was to attend to and fire a steam-heating boiler, and he was compelled to use a narrow passageway when inspecting the steam gauges. Two iron beams lay on the boiler, and the ends projected over the passage. The plaintiff attempted to move them out of the way by pushing with his body, when he felt pain in his stomach, became faint and weak, and was compelled to cease work and be assisted home. On the third day afterwards he vomited blood, and subsequently had a slight paralytic stroke. It was held that his condition was the result of an accident as defined in section 3693 of the statute and that the inquiry arose out of and in the course of his employment. The section reads: "The word 'accident,' as used in this article shall, unless a different meaning is clearly indicated by the context, be construed to mean an unexpected or unforseen event, happening suddenly and violently, with or without human fault and producing at the time objective symptoms of an injury."—Manning vs. Pomerene, 162 N. W., 492.

Liability of School District Trustees for Heating System.

Suit was brought by a materialman who furnished a heating apparatus for a public school building in Poplar Bluff, Mo., against the members of the board of directors of the school district, based on the failure of the board to require the contractor to execute a bond to the district conditioned for the payment of all material used in the work as required by Mo. Rev. St. 1909, § 1247. That statute declares that it shall be the duty of all officials, or agents of the state or municipalities, in making contracts for public work, to require every contractor to execute a bond in an amount to be fixed by such officials, boards, commission, etc., which bond shall be conditioned for the payment of material used in such work and for labor performed. It appeared that contractors contracted to equip the school building with a heating system, the contractors to provide all materials and perform all necessary work for its installation. The contractors executed a bond conditioned that, if they should comply with all the covenants in the contract and should protect the school district from every claim, demand, judgment or lien that might be had against the building to be erected and should repay to the school district all sums of money which they might pay to other persons on account of work and labor done or materials furnished, then it should be void. It was held that the bond, which did not comply with the statute in not providing for payment for materials, was not available as common-law obligation on which materialmen and subcontractors might sue, and, as the taking of the bond was a ministerial act, the trustees of the district were liable for their failure to demand a bond in accordance with the statute.—C. A. Burton Machinery Co. vs. Ruth (Mo), 194 S. W., 526.

Reasonable Return.

The Indiana Public Service Commission holds that a rate of but 1½ per cent to a light, heat and power company is confiscatory and if continued must result in a refusal of investors to put more money into the utility. The rights of the people are not affected by overcapitalization unless it reaches a point where the fixed charges are such as to break down the service. The capitalization is given but little consideration in determining the fair value of the property. **Re** Richmond Light, Heat & Power Co.

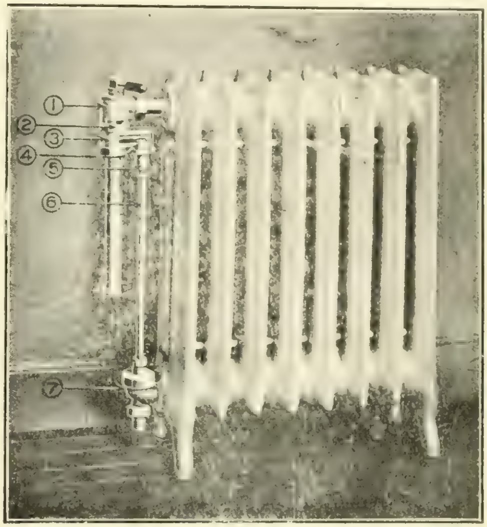
Valuation for Rate-Making.

The West Virginia Public Service Commission holds, that the rate-making value of a utility cannot be determined solely by the reproduction cost less depreciation plus appreciation, since the amount so determined is merely one of the elements which may be considered. It holds that the going value of a utility should be considered in a rate valuation; but a specific sum should not be allowed for such value, especially where no losses have been suffered in establishing the business. A utility is entitled to a sufficient income to enable it to set aside annually for depreciation, during the life of the utility, a sum which properly invested will amount to the present value of the plant. The depreciation of a natural gas company is more rapid than that of other utilities. **Re** Clarksburg Light & Heat Co.

NEW DEVICES

The Broomell Thermatic Modulation Valve.

The usual plan of vacuum heating is to equip the return end of the radiator with a thermostatic trap designed to close when steam begins to pass out at the return. In a new type of valve just brought out by the Vapor Heating Co., York, Pa., the thermostatic action takes place at the inlet to the radiator. This, in a word, is the distinguishing feature of this new device which, it is stated, has already received wide and enthusiastic endorsement. The valve is designed to operate with or without a vacuum pump and at any steam pressure from 5 oz. to 5 lbs. No trap, check valve, or fixture of any kind is on the return which is always open full size. The thermostatic disc does not come in direct contact with the steam or condensation, but absorbs heat from the disc holder.

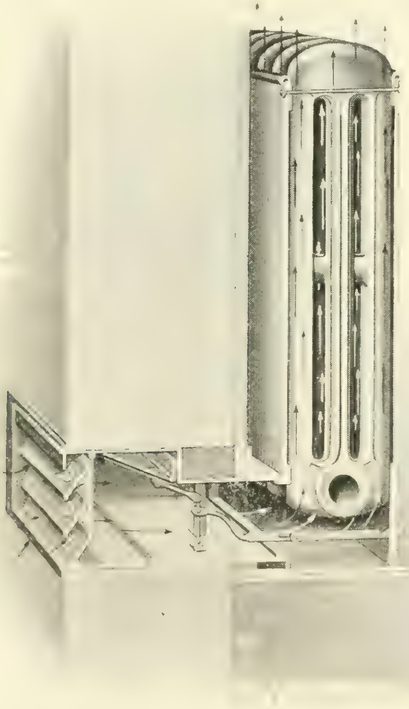


BROOMELL THERMATIC MODULATION VALVE.

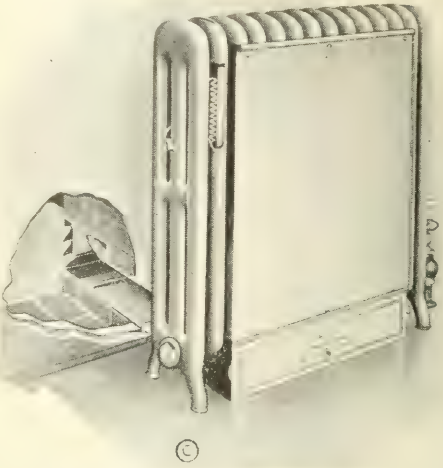
With the Broomell Thermatic system a vacuum is created in the radiator back to the inlet valve and this acts to keep the radiators from being air-bound. If the inlet valve leak or should the modulation valve be open slightly, it is possible to maintain a vacuum in the radiator, the steam to the radiator being condensed before it reaches the return outlet.

Trade Literature.

Westinghouse Electrical Equipment for Ventilating Service, for furnishing "pure air by wire," is the title of a new publication received from the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. After calling attention to the growth of building ventilation, and the company's development of electrical apparatus for use in this connection, the bulletin takes up the types of motors and their application, covering the important features of direct-current motors and direct-current controllers, and different types of alternating-current motors, including the squirrel-cage motor and the wound-rotor motor. Mention is also made of Westinghouse-Ventura and Sirocco blowers, this being supplemented by data on the "power required to drive fans and blowers," with formula. The illustrations include a large number of buildings which have been equipped with Westinghouse ventilating apparatus. Size 8½ × 11 in. (standard). Pp. 20.



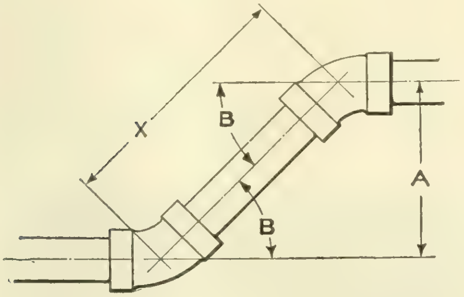
D-I CAST-IRON VENTILATING WALL BOX, EXTENSION SLEEVE AND ADJUSTABLE CONTROLLING FRESH AIR DAMPER.



RADIATOR EQUIPPED WITH D-I AUTOMATIC SUPPLY AND AIR RELEASE AND WITH HUMIDIFYING SECTION.

D-I Heating and Ventilating Specialties, for schools, hospitals and other public buildings, manufactured by C. C. Shipp & Co., Indianapolis, Ind., are brought to the attention of the trade in an elaborate catalogue. These specialties comprise a ventilating wall box which is, in reality, an opening in the wall of the building at the base of the radiator; an adjustable box base connection; an adjustable ventilating box base; adjustable air diffusers; an adjustable controlling fresh air damper indicator; and a removable air moistener, with automatic supply valve. All of the specialties are intended to provide for ventilation without drafts and without the use of fans or blowers. When assembled they form a metal channel for the passage of fresh air, leading from an opening in the wall of the building at the base of the radiator, in through the wall, then upward at a right angle through the sections of the radiator. The removable air moistener used with these specialties is hung on the upper half of the radiator between the radiator and the front adjustable air diffuser, the inside wall of the moistener being corrugated. The moistener is supplied with water of condensation by means of an automatic supply and siphon check valve. By this means the humidity is controlled automatically. This section and valve are one of the company's inventions, but are being manufactured and assembled by the American Radiator Company in its 38-in. three-column Peerless steam radiators, to be used in connection with the D-I ventilating specialties. A special section is devoted to "Method of Calculation for D-I Specialties." Numerous school and other buildings are shown equipped with this system, the catalogue concluding with capacities and price lists and the company's guarantee. Several pages are given up to the opinions of experts bearing out the claims made by the company in support of the method of heating and ventilating buildings. Size 8 × 11 in. Pp. 62.

VENTILATION, HEATING, DRYING is the title of a unique circular issued by W. L. Fleisher, Inc., New York, "contracting industrial engineers." This company has specialized in systems for steam, moisture and gas absorption in textile dye houses, and photographs are presented of several typical installations. The company's method of arranging hot water supply systems in such buildings is also taken up. The remainder of the circular discusses drying processes for factories and hot blast mill heating systems. The company states that it has a completely organized and equipped department for the designing and installation of power plants, piping systems and automatic sprinkler systems.



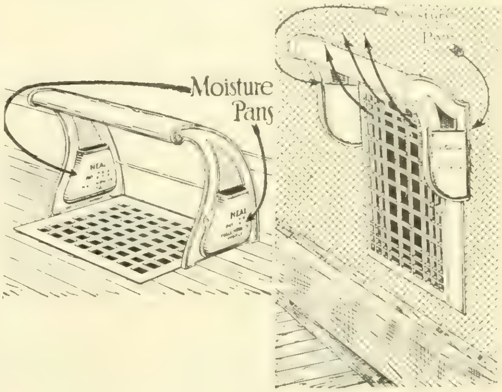
X (Center to Center) = A (Offset) Multiplied by Constant.

VALVE WORLD for July, 1917, the monthly periodical of Crane Co., Chicago, contains, among other things, an interesting formula for offset connections covering the various offsets used in general practice. In the accompanyng diagram X (center to center) = A (offset) multiplied by constant. The constants are as follows:

B-ANGLE	CONSTANT
60 Degrees	1.15
45 Degrees	1.41
30 Degrees	2.00
22½ Degrees	2.61
11¼ Degrees	5.12
5⅝ Degrees	10.20

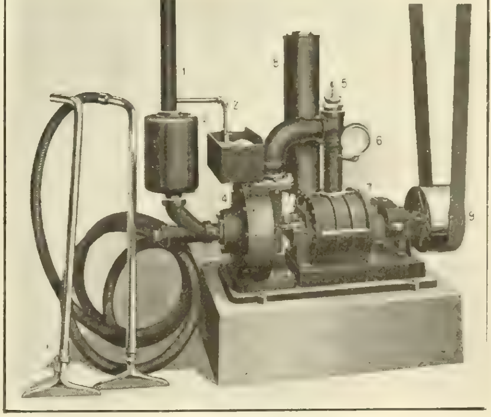
ON THE TRAIL OF BYERS PIPE, being an illustrated record of the service given by Byers pipe in heating, plumbing and power systems, installed from 25 to 40 years ago, is the title of an interesting booklet published by the A. M. Byers Co., Pittsburgh, Pa. The company has been fortunate enough to trace, through old files and old contractors, a number of old-time installations of Byers Pipe in different cities. In each case the facts are given about the condition of the pipe lines after long service, the whole constituting an impressive tribute to the durability of Byers genuine wrought-iron pipe. Pictures of the buildings accompany the notes and give a reminiscent touch to the booklet, at the same time impressing the reader with the Byers company's long and successful career. Size 4 × 6¼ in. Pp. 40.

NEAL'S PATENT REGISTER SHIELDS are an interesting product of the Hall Hardware Co., Indiaiapolis, Ind., featured in recent circular matter issued by this company. It will be noted that the shields are equipped with water pans for supplying humidity to the air. They are also made with pockets for catching the dust coming through in the air supply. They are made for both floor and wall installation, in various sizes. Floor shields with ½-gal. moisture pan capacity are also furnished.



TYPES OF NEAL REGISTER SHIELDS.

CONNERSVILLE VACUUM CLEANERS, centrifugal separating type, for laundries and carpet-cleaning establishments, are the subject of a recent circular issued by the United Vacuum Appliance Co., Connersville, Ind. The vac-



LATEST TYPE OF CONNERSVILLE VACUUM CLEANER, CENTRIFUGAL SEPARATING TYPE.

uum producer for these machines is the well-known Connersville double-impeller rotary blower, while the centrifugal separator is in the form of a rotor which turns within the separator case, separating the dirt and water from the air and discharging them into the sewer under no pressure. Because of this feature there are no tanks, bags, screens or buckets. The accompanying illustration, taken from the circular, shows a typical installation in the carpet-cleaning department of the Brooks Laundry Co., Oak Park, Ill.

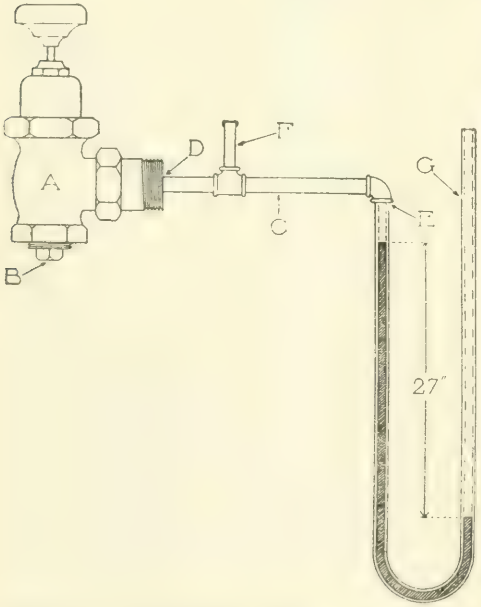
Look Inside for Details is the title of an ingeniously-designed circular devoted to the Carrier Air Washer, manufactured by the Carrier Air Conditioning Co., Buffalo, N. Y. The circular is so printed and folded as to show both the exterior and interior of the air washer, attention being called to different details of construction in a way that makes things very clear.

◆

Vacuum Held Thirty Days by Radiator Valve.

A test of a Sylphon packless radiator valve which held 27 in. of vacuum for thirty days is reported by W. M. Fulton, president of the Fulton Company in a recent issue of the Ideal Heating Journal. The valve A (see illustration) was tightly plugged at the bottom B, and small pipe C was soldered to tail-piece at D and hermetically connected to mercury U-tube G, at E. A vacuum pump was connected to the pipe F and a vacuum of about 27 in. was formed, and then the pipe F was hermetically sealed. The valve was allowed to remain connected in this way for thirty days, during which time the writer raised the disk to the full height above the seat, and pressed it down again tightly against the seat, one hundred times a day.

At the end of thirty days the height of the mercury column showed no change whatever, and there was no change in its height during the test, excepting a slight variation due to the change in barometric pressure of the atmosphere, as shown by the local weather bureau records.

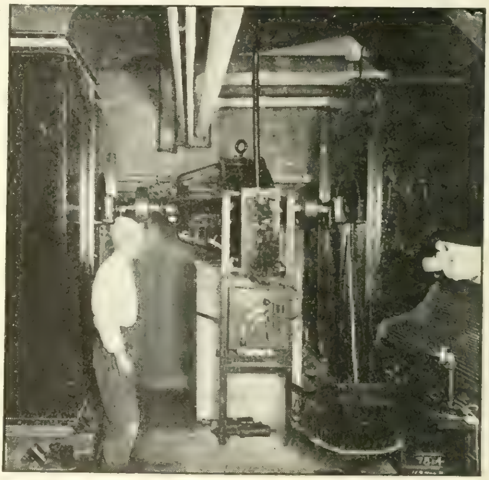


METHOD OF TESTING SYPHON PACKLESS RADIATOR VALVE.

◆

Compact Form of Motor Drive for Blowers.

The accompanying illustration shows a compact and economical form of motor drive for blowers as installed in the Postal Life Building, 511 Fifth Avenue, New York. The equipment consists of Sturtevant supply and exhaust fans direct-connected to a Westinghouse 20 h.p., 230 r.p.m. motor for ventilating the first two floors of this building. The speed of the motors may be reduced to 155 r.p.m. by the controller.



MOTOR DRIVE FOR BLOWERS INSTALLED IN POSTAL LIFE BUILDING, NEW YORK.

◆

Business Chances.

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following-named work:

Until September 21, 1917, for the construction of the U. S. Post Office at Kendallville, Ind.

VELOCITY IN VENT FLUES DUE TO HEATING AIR.

When air in a flue is heated above that of the outside air, into which the flue is opened, the flue air is expanded to a relatively greater volume and therefore has a relatively less weight than the outside air. This state results in a tendency to equalize the unbalanced condition, giving motive power to produce a draft in the flue largely similar to the action of a common chimney.

Ventilation operated by heating the air in vertical flues is termed a "gravity" system but cannot be recommended on account of troubles due to non-positive results, back-drafts, etc. Owing to cheapness such flues are often used and when so employed should be figured conservatively to allow for friction and other retardents. The following table is thought to be as reliable as any table can be when made to fit a set of conditions which are not positive.

VENT FLUE VELOCITIES IN FEET PER MINUTE.

Height of flue in feet	Temperature in flue above outside temperature, in degrees, Fahr.						
	5°	10°	15°	20°	30°	50°	100°
	Velocity in Flue in Feet Per Minute.						
5	55	76	94	109	134	167	242
10	77	108	133	153	188	242	342
15	94	133	162	188	230	297	419
20	108	153	188	217	265	342	484
25	121	171	210	242	297	383	541
30	133	188	230	265	325	419	593
35	143	203	248	286	351	453	640
40	153	217	265	306	375	484	684
45	162	230	282	325	398	514	724
50	171	242	297	342	419	541	765
60	188	264	325	373	461	594	835
100	238	342	420	485	594	768	1080

AREA IN SQUARE FEET OF ANY ROUND, SQUARE OR RECTANGULAR PIPE FROM 8 INCHES TO 8 FEET

Side or Diameter Inches	Round Pipe	Square or Oblong Pipe																											
8	0.35	0.45																											
9	0.44	0.50	0.56																										
10	0.55	0.56	0.62	0.69																									
11	0.66	0.61	0.69	0.76	0.84																								
12	0.79	0.67	0.75	0.83	0.92	1.00																							
13	0.92	0.72	0.81	0.90	0.99	1.08	1.17																						
14	1.07	0.78	0.87	0.97	1.06	1.17	1.26	1.36																					
15	1.23	0.83	0.94	1.04	1.14	1.25	1.35	1.46	1.56																				
16	1.39	0.89	1.00	1.11	1.22	1.33	1.44	1.55	1.67	1.78																			
17	1.57	0.94	1.06	1.18	1.29	1.42	1.53	1.65	1.77	1.89	2.01																		
18	1.76	1.00	1.12	1.25	1.37	1.50	1.62	1.75	1.87	2.00	2.12	2.25																	
19	1.97	1.06	1.19	1.32	1.45	1.58	1.71	1.84	1.98	2.11	2.24	2.37	2.50																
20	2.18	1.11	1.25	1.38	1.52	1.67	1.80	1.94	2.08	2.22	2.36	2.50	2.63	2.78															
22	2.64	1.22	1.38	1.52	1.68	1.83	1.98	2.13	2.29	2.44	2.60	2.75	2.90	3.05	3.36														
24	3.14	1.33	1.50	1.67	1.83	2.00	2.17	2.33	2.50	2.67	2.83	3.00	3.17	3.33	3.67	4.00													
26	3.69	1.44	1.62	1.80	1.98	2.17	2.34	2.53	2.71	2.89	3.07	3.25	3.43	3.62	3.97	4.33	4.70												
28	4.27	1.56	1.75	1.94	2.14	2.33	2.52	2.72	2.92	3.11	3.30	3.50	3.69	3.89	4.28	4.67	5.06	5.45											
30	4.90	1.67	1.88	2.08	2.29	2.50	2.71	2.92	3.12	3.33	3.54	3.75	3.96	4.17	4.58	5.00	5.41	5.83	6.25										
32	5.58	1.78	2.00	2.22	2.44	2.67	2.89	3.11	3.33	3.56	3.78	4.00	4.22	4.44	4.89	5.33	5.78	6.22	6.67	7.11									
34	6.30	1.89	2.12	2.36	2.59	2.83	3.07	3.30	3.54	3.78	4.02	4.25	4.48	4.72	5.19	5.67	6.15	6.61	7.09	7.56	8.03								
36	7.06	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00							
38	7.87	2.11	2.38	2.63	2.90	3.17	3.43	3.69	3.96	4.22	4.50	4.75	5.01	5.28	5.80	6.33	6.86	7.39	7.91	8.44	8.97	9.50	10.03						
40	8.73	2.22	2.50	2.77	3.05	3.33	3.61	3.89	4.17	4.44	4.73	5.00	5.28	5.56	6.11	6.67	7.23	7.78	8.33	8.89	9.44	10.00	10.56	11.11					
42	9.62	2.33	2.62	2.91	3.21	3.50	3.79	4.08	4.38	4.67	4.96	5.25	5.54	5.83	6.42	7.00	7.58	8.17	8.75	9.33	9.91	10.50	11.09	11.67	12.25				
44	10.56	2.44	2.75	3.05	3.36	3.67	3.97	4.28	4.58	4.89	5.19	5.50	5.81	6.11	6.71	7.33	7.94	8.56	9.16	9.78	10.38	11.00	11.61	12.22	12.83	13.44			
46	11.54	2.56	2.88	3.19	3.51	3.83	4.15	4.47	4.79	5.11	5.44	5.75	6.07	6.38	7.01	7.67	8.31	8.95	9.58	10.22	10.85	11.50	12.14	12.78	13.42	14.06	14.69		
48	12.56	2.67	3.00	3.33	3.67	4.00	4.33	4.67	5.00	5.33	5.67	6.00	6.33	6.67	7.33	8.00	8.67	9.33	10.00	10.67	11.33	12.00	12.67	13.33	14.00	14.67	15.33	16.00	
50	13.63	2.78	3.12	3.47	3.82	4.17	4.51	4.86	5.21	5.56	5.92	6.25	6.60	6.95	7.63	8.33	9.03	9.72	10.42	11.11	11.80	12.50	13.20	13.89	14.58	15.28	15.97	16.67	17.36
Side of pipe inches		8	9	10	11	12	13	14	15	16	17	18	19	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50

AREA IN SQUARE FEET OF ANY ROUND, SQUARE OR RECTANGULAR PIPE FROM 8 INCHES TO 8 FEET

SIZE OF PIPE - - INCHES

SIZE OF PIPES - - INCHES	96	94	92	90	88	86	84	82	80	78	76	74	72	70	68	66	64	62	60	58	56	54	52
96	64.00	62.67	61.33	60.00	58.67	57.33	56.00	54.67	53.33	52.00	50.67	49.33	48.00	46.67	45.33	44.00	42.67	41.33	40.00	38.67	37.33	36.00	34.67
94		61.36	60.05	58.75	57.43	56.14	54.83	53.53	52.22	50.92	49.61	48.30	47.00	45.70	44.39	43.08	41.78	40.47	39.17	37.86	36.56	35.25	33.95
92			58.78	57.50	56.23	54.95	53.67	52.39	51.11	49.83	48.56	47.28	46.00	44.72	43.44	42.16	40.89	39.61	38.33	37.05	35.78	34.50	33.23
90				56.25	55.00	53.75	52.50	51.25	50.00	48.75	47.50	46.25	45.00	43.75	[illegible]	41.25	40.00	38.75	37.50	36.25	35.00	33.75	32.50
88					53.77	52.55	51.33	50.11	48.89	47.67	46.44	45.22	44.00	42.78	41.55	40.33	39.11	37.89	36.67	35.44	34.22	33.00	31.78
86						51.36	50.17	48.97	47.78	46.58	45.39	44.19	43.00	41.81	40.61	39.42	38.22	37.03	35.83	34.63	33.44	32.25	31.05
84							49.00	47.83	46.67	45.50	44.33	43.16	42.00	40.84	39.67	38.50	37.33	36.17	35.00	33.83	32.67	31.50	30.33
82								46.69	45.55	44.41	43.28	42.14	41.00	39.86	38.72	37.58	36.44	35.31	34.17	33.03	31.89	30.75	29.61
80									44.44	43.33	42.22	41.11	40.00	38.89	37.78	36.67	35.56	34.44	33.33	32.22	31.11	30.00	28.89
78										42.25	41.17	40.08	39.00	37.92	36.83	35.75	34.67	33.58	32.50	31.42	30.33	29.25	28.17
76											40.11	39.05	38.00	36.94	35.89	34.83	33.78	32.72	31.67	30.61	29.56	28.50	27.44
74												38.03	37.00	35.97	34.94	33.92	32.89	31.86	30.83	29.80	28.78	27.75	26.72
72													36.00	35.00	34.00	33.00	32.00	31.00	30.00	29.00	28.00	27.00	26.00
70														34.03	33.06	32.08	31.11	30.14	29.17	28.19	27.22	26.25	25.28
68															32.11	31.16	30.22	29.28	28.33	27.39	26.44	25.50	24.56
66																30.25	29.33	28.42	27.50	26.58	25.67	24.75	23.83
64																	28.44	27.56	26.67	25.78	24.89	24.00	23.11
62																		26.69	25.83	24.97	24.11	23.25	22.39
60																			25.00	24.17	23.33	22.50	21.67
58																				23.36	22.56	21.75	20.94
56																					21.78	21.00	20.23
54																						20.25	19.50
52																							18.78

(Note—For last portion of Table see Sheet No. 10-K)

AREA IN SQUARE FEET OF ANY ROUND, SQUARE OR RECTANGULAR PIPE FROM 8 INCHES TO 8 FEET.

Side or Diameter Inches	Round Pipe	AREA OF SQUARE OR RECTANGULAR PIPES IN SQUARE FEET																											
52	14.75	2.89	3.25	3.61	3.97	4.33	4.69	5.06	5.41	5.78	6.15	6.50	6.86	7.23	7.93	8.67	9.39	10.11	10.83	11.56	12.28	13.00	13.73	14.44	15.17	15.88	16.61	17.33	18.06
54	15.90	3.00	3.30	3.75	4.13	4.50	4.88	5.25	5.62	6.00	6.38	6.75	7.13	7.50	8.25	9.00	9.75	10.50	11.25	12.00	12.75	13.50	14.25	15.00	15.75	16.50	17.25	18.00	18.75
56	17.10	3.11	3.58	3.88	4.28	4.67	5.05	5.44	5.83	6.22	6.61	7.00	7.39	7.77	8.56	9.33	10.11	10.89	11.67	12.44	13.22	14.00	14.78	15.55	16.33	17.12	17.88	18.67	19.44
58	18.34	3.22	3.62	4.02	4.43	4.83	5.23	5.64	6.04	6.44	6.85	7.25	7.65	8.06	8.86	9.67	10.47	11.28	12.08	12.89	13.69	14.50	15.31	16.11	16.92	17.72	18.53	19.33	20.14
60	19.63	3.33	3.75	4.16	4.59	5.00	5.41	5.83	6.25	6.67	7.10	7.50	7.92	8.33	9.17	10.00	10.83	11.67	12.50	13.33	14.17	15.00	15.85	16.67	17.50	18.33	19.16	20.00	20.84
62	20.96	3.44	3.88	4.30	4.74	5.17	5.59	6.02	6.46	6.89	7.32	7.75	8.18	8.61	9.47	10.33	11.21	12.06	12.92	13.78	14.64	15.50	16.37	17.22	18.08	18.95	19.80	20.67	21.53
64	22.34	3.56	4.00	4.44	4.88	5.33	5.77	6.22	6.67	7.11	7.56	8.00	8.42	8.89	9.77	10.67	11.56	12.44	13.33	14.22	15.11	16.00	16.90	17.77	18.67	19.56	20.44	21.33	22.22
66	23.76	3.67	4.12	4.58	5.05	5.50	5.95	6.41	6.87	7.33	7.80	8.25	8.71	9.17	10.08	11.00	11.91	12.83	13.75	14.67	15.58	16.50	17.43	18.33	19.25	20.17	21.08	22.00	22.92
68	25.21	3.78	4.25	4.72	5.19	5.67	6.13	6.61	7.08	7.56	8.04	8.50	8.98	9.46	10.39	11.33	12.28	13.22	14.17	15.11	16.05	17.00	17.95	18.88	19.83	20.78	21.72	22.67	23.61
70	26.72	3.89	4.38	4.86	5.34	5.83	6.31	6.80	7.29	7.78	8.26	8.75	9.24	9.73	10.67	11.67	12.64	13.61	14.58	15.56	16.53	17.50	18.48	19.44	20.42	21.38	22.36	23.33	24.30
72	28.27	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	25.00
74	29.86	4.11	4.62	5.14	5.65	6.17	6.68	7.19	7.71	8.22	8.76	9.25	9.76	10.28	11.30	12.33	13.36	14.39	15.42	16.44	17.47	18.50	19.53	20.56	21.58	22.61	23.63	24.67	25.69
76	31.50	4.22	4.75	5.27	5.80	6.33	6.86	7.39	7.91	8.44	8.97	9.50	10.03	10.56	11.60	12.67	13.72	14.78	15.83	16.89	17.94	19.00	20.06	21.11	22.17	23.22	24.27	25.33	26.39
78	33.18	4.33	4.88	5.41	5.95	6.50	7.04	7.58	8.12	8.67	9.21	9.75	10.29	10.83	11.91	13.00	14.08	15.17	16.25	17.33	18.41	19.50	20.59	21.67	22.75	23.83	24.91	26.00	27.08
80	34.90	4.44	5.00	5.56	6.11	6.67	7.22	7.78	8.33	8.89	9.44	10.00	10.56	11.11	12.22	13.33	14.44	15.56	16.67	17.78	18.89	20.00	21.11	22.22	23.33	24.44	25.56	26.67	27.78
82	36.67	4.56	5.12	5.69	6.26	6.83	7.40	7.97	8.54	9.11	9.68	10.25	10.82	11.39	12.53	13.67	14.80	15.94	17.08	18.22	19.36	20.50	21.64	22.77	23.92	25.06	26.19	27.33	28.47
84	38.48	4.67	5.25	5.83	6.42	7.00	7.58	8.17	8.75	9.33	9.92	10.50	11.08	11.67	12.83	14.00	15.17	16.33	17.50	18.67	19.83	21.00	22.17	23.33	24.50	25.67	26.83	28.00	29.17
86	40.33	4.78	5.38	5.97	6.57	7.17	7.76	8.36	8.96	9.56	10.15	10.75	11.34	11.94	13.14	14.33	15.53	16.72	17.92	19.11	20.30	21.50	22.70	23.89	25.09	26.29	27.46	28.67	29.86
88	42.24	4.89	5.50	6.11	6.72	7.33	7.94	8.56	9.16	9.78	10.39	11.00	11.61	12.22	13.44	14.67	15.90	17.11	18.33	19.56	20.78	22.00	23.22	24.44	25.67	26.90	28.10	29.33	30.56
90	44.18	5.00	5.62	6.25	6.88	7.50	8.12	8.75	9.37	10.00	10.62	11.25	11.88	12.50	13.75	15.00	16.25	17.50	18.75	20.00	21.25	22.50	23.75	25.00	26.25	27.50	28.75	30.00	31.25
92	46.16	5.11	5.75	6.38	7.02	7.67	8.30	8.94	9.58	10.22	10.86	11.50	12.14	12.80	14.06	15.33	16.61	17.89	19.17	20.44	21.72	23.00	24.28	25.56	26.83	28.11	29.37	30.67	31.94
94	48.19	5.22	5.88	6.52	7.18	7.83	8.48	9.14	9.79	10.44	11.10	11.75	12.40	13.06	14.36	15.67	16.97	18.28	19.58	20.89	22.19	23.50	24.81	26.11	27.42	28.72	30.00	31.33	32.64
96	50.26	5.33	6.00	6.67	7.33	8.00	8.67	9.33	10.00	10.67	11.33	12.00	12.67	13.33	14.67	16.00	17.33	18.67	20.00	21.33	22.67	24.00	25.33	26.67	28.00	29.33	30.67	32.00	33.33
Side of Pipe Inches		8	9	10	11	12	13	14	15	16	17	18	19	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50

(Note—For first portion of table see Sheet No. 10-J.)

THE HEATING AND VENTILATING MAGAZINE - 1123 BROADWAY - N.Y. CITY.

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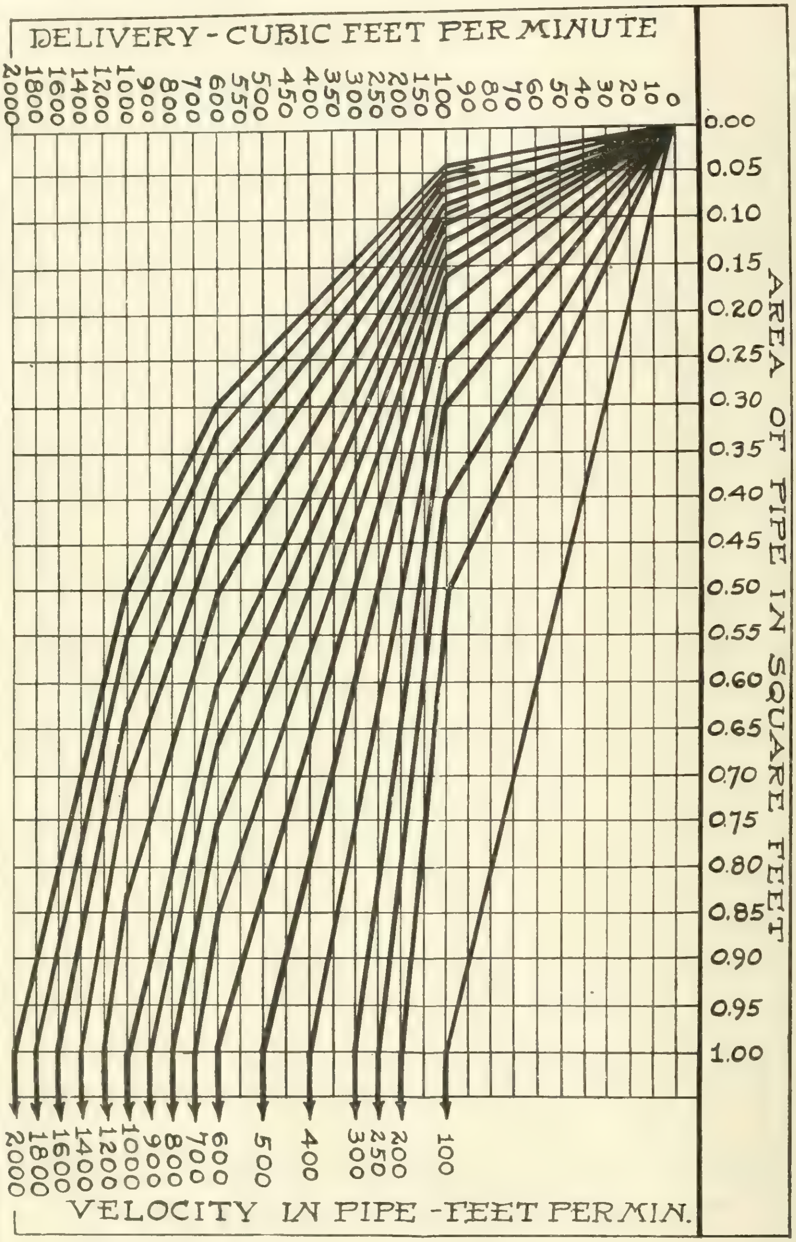

NOTE—For areas of pipe larger than those given in curves move the decimal point of the given area one or two places to left so as to reduce the area to within the limits between zero and 1.00; read the result from the curve and add the same number of ciphers to the result as the number of places the decimal point was moved.

PIPE CAPACITIES AT VARIOUS VELOCITIES | **NO. 10-J**

The Heating and Ventilating Magazine

VOL. XIV. NO. 10

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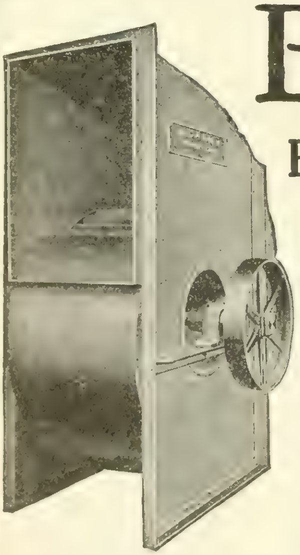

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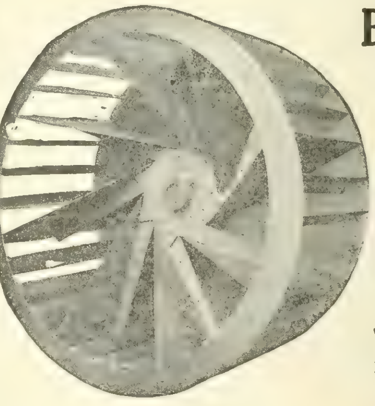

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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. October, 1917 1123 Broadway, New York

How to Fire the Down-Draft Smokeless Boiler

Important Points to Consider in Obtaining the Required Efficiency with This Type of Heater.

By A. BEMENT.

After preparing the original manuscript for this article the writer had occasion to make a considerable investigation of furnace equipment for apartment house boilers as now made for burning bituminous coal and found that many down-draft boilers are improperly designed. At the time of writing he was aware that this was true of certain makes, but did not realize that it applied to so large a number.

The leader will therefore understand that what follows applies to a properly-designed furnace, and should be of especial value in setting forth the possibilities of the down-draft principle.

The manner in which present design fails is in making it impossible to poke the fire as specified, and in not providing for a sufficient fuel bed on the water grate.

What is generally known as the smokeless boiler in the low-pressure heating service of apartment houses and residences for bituminous coal, is the old Hawley down-draft furnace adapted to a new service. This furnace is what may be called a two-story affair, having two fire grates, one above the other. The upper is composed of pipes which are connected to the boiler, and through which water circulates, so in fact the grate is a part of the boiler. The lower is an ordinary cast-iron grate which may be a shaking grate or not. The fire is on the upper grate and burns downward, so it may be said to burn upside down. Fresh coal is placed on the top of the fuel bed, and the volatile gases which are distilled from it must pass, together with the air for combustion, down through the incandescent portion of the fuel bed, where complete combustion is assured, because the volatile combustible matter and the air are forced together during their passage through the hot zone. This performance is just opposite to that of an ordinary fire, in which the evolved volatile is flowing away from a hot, to a cooler zone, also with which there is no compelling influence to cause contact between and a mixing together of the volatile and the air.

A considerable quantity of live coals fall from between the water bars upon the lower grate, where they are burned. As all the volatile has been distilled from them, they of course do not smoke. The ashes also fall from the upper to the lower grate.

The down-draft furnace has certain advantages which must be defined and explained, if we are to have a complete exposition of the subject. It also has some disadvantages which must also be considered. Taking the advantages first, they are six in numbers as follows:

SIX ADVANTAGES AND TWO DISADVANTAGES OF DOWN-DRAFT FURNACES.

1. It is, without any exception, the best coal-burning method.
2. When properly operated, it is absolutely smokeless with any coal.
3. Will burn any and every kind of coal.
4. Never troubled by clinkers.
5. Not ever necessary to interrupt the performance for the purpose of cleaning fires.
6. Will produce most economical combustion.

The disadvantages are two in number as follows:

1. First cost is higher than common inefficient apparatus.
2. Successful results depend upon proper manipulation, or in other words, it is a labor problem.

The requirement for efficient combustion of bituminous coal, is that the volatile matter be *thoroughly mixed* with the air at *high temperature*. This occurs with the down-draft principle, as the volatile which is distilled from the upper layer of freshly-ignited coal, must pass in many finely-divided streams between the incandescent coals in the bottom of the fire. At the same time, the air must take the same path, with the result that it is brought intimately and immediately in contact with all the volatile carbon, oxidizing it to carbon dioxide, or CO_2.

This performance differs from that of an automatic mechanical stoker, with which coal is supplied at a uniform rate, and from which the combustible gas rises in the form of masses of flames, which must be kept hot by means of a combustion chamber, until their combustion is completed. Thus the stoker does not produce immediate complete combustion at, or in, the fuel bed, the burning of the gases being a supplemental or secondary performance. The complete mechanical stoker furnace, of course, gives excellent results, but it is a machine which is not applicable to low-pressure heating plants, and it can not burn all grades and kinds of fuel.

NO SMOKE WITH A PROPERLY FIRED HEATER.

The second advantage, that of smokelessness, is a feature that must be considered seriously in connection with the mode of firing. If the heater is properly fired there can be no smoke, but it may easily be so fired that it will smoke outrageously.

As the fuel lies quietly on the upper grate, it burns absolutely without smoke. The fuel bed, however, after a time becomes caked and fused together, with the result that the rate of combustion drops below requirements. When this occurs, the fire should be loosened up by running a long slice bar *under* the fire along the water bars clear to the *back* of the furnace. The bar should then be pressed down just enough to pry up the fuel bed, sufficient to crack the caked masses, just enough to open air passages, but *not enough to disturb the condition of the fire*. This slicing should be extended across the furnace till the entire bed has been freed and made porous. The insertion of the slice bar will cause some incandescent coals to fall down to the lower grate, where they will be burned later. The slice bar will also dislodge the accumulated ash which will also drop to the bottom grate. After the slicing is finished, the hot coals on the bottom grate will rest in irregular piles, these should be leveled off with a rake or hoe, so that the fire on this grate will be perfectly level and uniform. After this has been done, the fuel bed on the top grate should be replenished by the addition of fresh fuel, which will complete a full cycle of operation. The frequency of these cycles will depend on the load on the boiler; when much steam is required, they should be performed at correspondingly frequent intervals, when little steam is needed, at correspondingly long periods.

EXAMPLES OF IMPROPER FIRING.

Having described proper firing, it is necessary, to explain how the furnace may be, and is often improperly fired. Frequenty the slice bar is only run part way back, then the fire is much broken up and turned upside down on the front, with the result that much green coal falls to the lower grate where it lies in piles, and, burning there, makes much smoke. The back of the fuel bed, not being disturbed, cakes up and at the same time allows the ashes to accumulate which fuse into clinkers. This results also in reducing the capacity of the furnace and producing a mass of clinker which must be dug out, sometimes with much labor. In other instances the entire fire is violently sliced, the fuel bed from front to back turned upside down, with the result that much green coal drops to the lower grate, producing a great quantity of smoke. Sometimes the fuel bed is not sliced at all, or, if it is, only at long intervals. The result of this is that the fire seals up, clinkers form and cover the water bars till not enough steam is made to satisfy demands. Then fresh coal is shoveled on the lower grate and the furnace is operated the same as any plain grate. It is under this latter condition that enormous volumes of smoke are made. Many of the readers of this article may question the accuracy of the statement that the down-draft is a smokeless and efficient furnace when properly operated. Their reason for doubting is possibly because their ideas of its capabilities are based only upon improper operation.

ABILITY TO USE ANY KIND OF FUEL A DECISIVE FEATURE.

Ability to use any kind of fuel that may be available is always desirable, especially under present conditions and particularly so under conditions that will exist in the near future. This is a strong point of the down-draft furnace. It can use successfully bituminous lump, egg, mine run or screenings, as well as semi-bituminous, all on the top grate in the regular way. The only fuel that can not be used is dubb as it is so small that it will fall through the bars. The smaller sizes of washed coal are the least desirable, but they may be used. Coke may be used as well as coal. Anthracite may be burned on the lower grate if it is too slow for the upper fire, as it does not smoke. Under such conditions, the fire door for the upper grate must be closed tight. Wood and like refuse that accumulates at an apartment house and must be disposed of, may be burned on the lower grate.

CLINKER TROUBLE AN EVIDENCE OF BAD FIRING.

One of the frequent complaints that coal dealers receive from users of the down-draft boiler, is that their coal clinkers. There is no reason whatever for such complaint. Clinker trouble is always an evidence of bad firing. With proper manipulation no clinkers are formed on the top grate, even with the dirtiest of screenings. If the fire is properly sliced, all the ash will be dislodged and fall to the bottom grate, where it does, to some extent, fuse together in small clinkers, but these are readily removed as this fire is thin and easily cleaned.

BEST METHOD OF CLEANING FIRE.

The down-draft fire is very easily cleaned, in fact, the easiest to clean of all fires. As all of the ash falls to the bottom grate, it may be easily raked out without in any way disturbing the main fire, which is on the water bars above. The best method of cleaning, however, is to remove a portion of the ash each time the fuel bed is sliced. Just before slicing, the small clinkers should be raked out from the bottom grate, and depending on the amount present, a portion of the ashes may also be removed. The remaining ashes and fire should be well spread and leveled. Then when the top fire has been sliced, the hot coals which have fallen from the top fire, should be well spread and leveled on the bottom grate. It is better not to remove all the ashes from the grate; about an average amount should be left, because if they are all cleaned off, too much air will flow through the bare grate and reduce the efficiency. So it is best to maintain a thin bed of ashes on the grate to exclude this excess of air.

CONTROL OF AIR SUPPLY AND ITS BEARING ON ECONOMICAL OPERATION.

The foregoing has largely dealt with the matter of securing complete combustion, and the handling of the ash. The matter of the control of the air supply, the feature which applies to the sixth advantage of the down-draft furnace, is the one which has the most important bearing on economy. This requires some detailed explanation. Air contains 21% oxygen and 79% nitrogen. It is the oxygen that does the work, it enters into combination with the carbon and hydrogen of the fuel to produce combustion. The nitrogen takes no part in the process, it acts simply as a dilutent of the products of combustion. Therefore our interest centers in the oxygen, of which about three parts are used for combustion of the hydrogen of the coal. The combustion of hydrogen results in the production of water, which, at furnace temperature, is in the form of steam, and for this reason not easily determined in a chemical analysis of the combustion gases, so is not directly considered in studying air supply.

As three parts of oxygen are used for the hydrogen, there remains 18 parts for carbon. The result of the combustion of carbon is that the volume of the CO_2 produced is the same as the oxygen which entered into the combination. In other words, the oxygen is of the same volume after the carbon is added, as it was before. It is heavier, of course, but not larger. It may be said that the carbon is absorbed by the oxygen. This fact simplifies the analysis of combustion gases, because if our analysis shows 18% CO_2, we know immediately that we have used all of our air in combustion. This would be a perfect condition, the maximum efficiency of combustion, which could be no better. If, however, our analysis shows 9% CO_2, we know that we have supplied twice the amount of air that we have used; in other words, that air is in excess by 100%. If we get 4.5% CO_2, we know that we have supplied four times the air needed or 400%. If 2.25% CO_2 eight times or 800%.

In heating a boiler, practically all the heat which does not go into the boiler escapes in the hot gases to the chimney. Therefore if we use eight times as much air as necessary, we have eight times more gases to go to the chimney, consequently eight times as much heat wasted. Fig. 1 is a curve illustrating heat losses to the chimney for different percentages of CO_2. It shows that when CO_2 gets down to about 1.5%, the coal being burned does no work at all. An extreme condition, of course, but one which for comparatively short periods often exists.

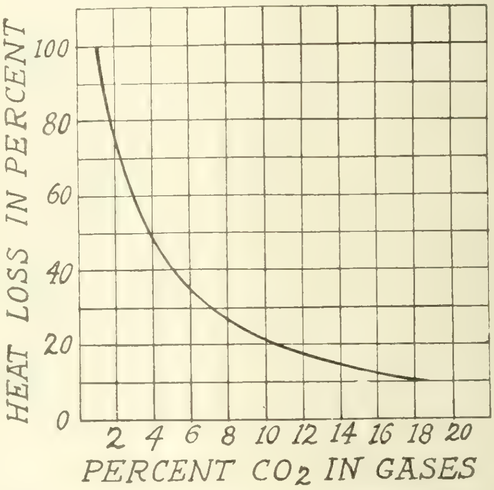


FIG. 1—HEAT LOSSES TO CHIMNEY FOR DIFFERENT PERCENTAGES OF CO_2.

While the foregoing illustrates the fact of the great importance of proper proportions between air and fuel, it gives no hint as to how the air may be controlled. We do not see the air and it is difficult to realize that for each ton of coal supplied to the furnace, at least 12 tons of air is also supplied, and that the amount may be, under bad conditions, as high as 100 tons, for each ton of coal. Of course an analysis would give this information at once, but this is out of the question in the kind of service that is under consideration. So it is absolutely necessary that we find some other simple path which leads to the solution of the air supply matter. Fortunately there is such a path. It consists in eliminating from our problem the idea of air, and in its place substituting the idea of draft. Draft is something applying to dampers, ventilators in fire doors, etc., things that every janitor and fireman understand.

AIR CONTROL EXPRESSED IN TERMS OF DRAFT.

A strong draft causes a large flow of air into the furnace, a mild draft a small flow. When a large amount of steam is required, much air is needed, when little steam is needed, little air is sufficient. Thus adjustment of drafts takes care of the air supply matter, as draft and air supply in this connection are synonymous. Now as air supply, or, in other words, draft, must be in proportion to the amount of steam needed, it necessarily follows that fuel must also be supplied in sufficient amount to satisfy this air. The way to do this is to maintain at all times a fuel supply, or a fire condition sufficient to satisfy the maximum draft conditions. Then with strong draft the fire will burn fast, with mild draft it will burn slow. The *efficiency* of combustion will be uniformly high, and the *rate* of heat production in proportion to requirements for steam.

To secure the results above described a sufficiently thick fire must be maintained on the upper grate, to insure that there shall always be an ample supply of combustible to satisfy whatever amount of air may flow through it. In this way the fire-bed becomes a fuel-magazine always ready to respond to any demand, or to lay semi-dormant.

THICKNESS OF FIRE DEPENDS ON KIND OF COAL USED.

The proper thickness of fire depends upon the size of the coal. Screenings, being a small fuel, makes a compact bed, consequently it need not be very thick. Lump coal is a large fuel, is not compact, as there are large interstices between the pieces. With its use the fire must be very thick, or else air will flow through the spaces without coming in contact with burning fuel. Mine-run coal, composed of both large and small sizes, should be maintained at a thickness midway between that for lump and screenings. Holes should never be allowed to form in the fuel bed. The fire on the bottom grate should be kept level and uniform.

The draft-opening at the fire door of the upper grate should be adjusted to give the capacity required. The draft-opening in the ash pit door below the lower grate, should be set so as to admit only sufficient air to uniformally burn the coal that drops to it, the idea being that the fuel on this grate should last from one poking period to another. If too much draft is given, this fire will burn away and leave a bare grate, allowing excessive air to enter. If draft enough is not admitted, the fire will accumulate on this grate.

The draft-openings in the middle door, the one between the grates, should be closed except when wood or rubbish is burned.

The manipulation of the drafts together with the stack damper, either by hand or automatically, to correspond with the load on the boiler, will always give an economical and satisfactory result, if the fire is kept at suitable thickness and in proper condition.

The effect of good and bad firing is illustrated by the curve of CO_2 in Fig. 2, showing combustion with different kinds of firing. The period taken is six hours, although this time is purely arbitrary and simply assumed for purpose of demonstration. Such diagrams as this are made for the purpose of study and research, and they show in great detail and in a very exact manner, just what happens at any moment. In other words they present the combustion performance in a pictorial manner. To get the data to plot a curve like this requires that analysis be made at intervals of two or three minutes, a lot of work, but justified by the value of the educational result.

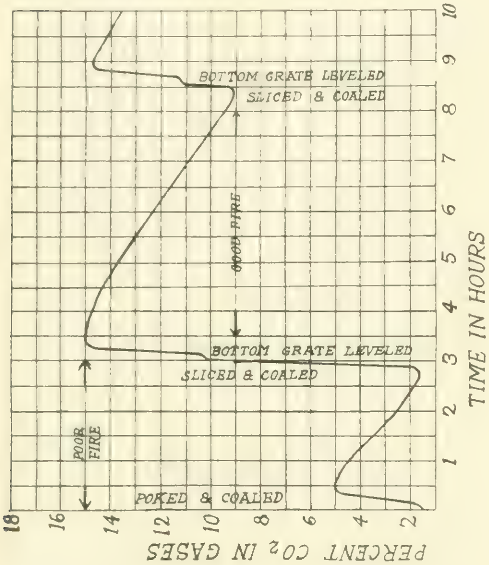


FIG. 2—RECORD OF COMBUSTION UNDER DIFFERENT KINDS OF FIRING.

At the start the CO_2 was 1.5, a little careless poking and recoaling causes it to rise to 5. That it went no higher is because the fuel thickness was not enough, while there were holes in the fire and the bottom grate was not leveled. The result was that in an hour and a half the CO_2 had dropped again to a point at which no steam was produced in the boiler. This interval on the diagram is indicated as poor firing. What the loss for different periods of the hour and a half was is also shown.

At the end of the three-hour period, after some clinkers had been removed from the bottom grate. the fire was properly sliced and coaled which resulted in a rise of CO_2 to 10. The coals on the bottom grate were leveled and drafts set which put it to 15. After this combustion proceeded for about six hours, at which time the CO_2 had dropped to 9%, when the process was repeated. This shows good firing, with an average of 12 CO_2 and an effciency of 82%. While the poor condition averages 3 CO_2, with an efficiency of about 35%.

The down-draft boiler costs a little more than the common one but it has so many advantages that more than justify the additional cost. It also requires a certain higher standard of operation than would pass muster with a common boiler. This, however, does not mean more labor, because the hard part of operating a common boiler is the cleaning of the fire which is very easy with the down-draft. Its higher efficiency requires the use of less coal so that there is less to handle.

Smoke Abatement Activities in American Cities

1—NEW YORK.

By JOSEPH M. LONERGAN,

Assistant Director, Sanitary Bureau, New York City Department of Health.

The enforcement of the ordinance prohibiting the discharge of dense smoke in the City of New York is within the purview of the Department of Health.

The law covering this subject is embraced in Section 211 of the Sanitary Code, which is as follows:

> DISCHARGE OF DENSE SMOKE PROHIBITED—No person shall cause, suffer, or allow dense smoke to be discharged from any building, vessel, stationary or locomotive engine or motor vehicle, place or premises within the CITY of New York, or upon the waters adjacent thereto, within the jurisdiction of said City. All persons participating in any violation of this provision, either as proprietors, owners, tenants, managers, superintendents, captains, engineers, firemen, or motor vehicle operators, or otherwise, shall be severally liable therefor.

Heretofore, the City of New York has been a hard coal user. We have been fortunate in our proximity to the anthracite mines of Pennsylvania and accessible to the coal mined there. The present unfortunate coal situation has changed conditions in this city materially, and it is probably true that more bituminous coal is now in use here than ever before.

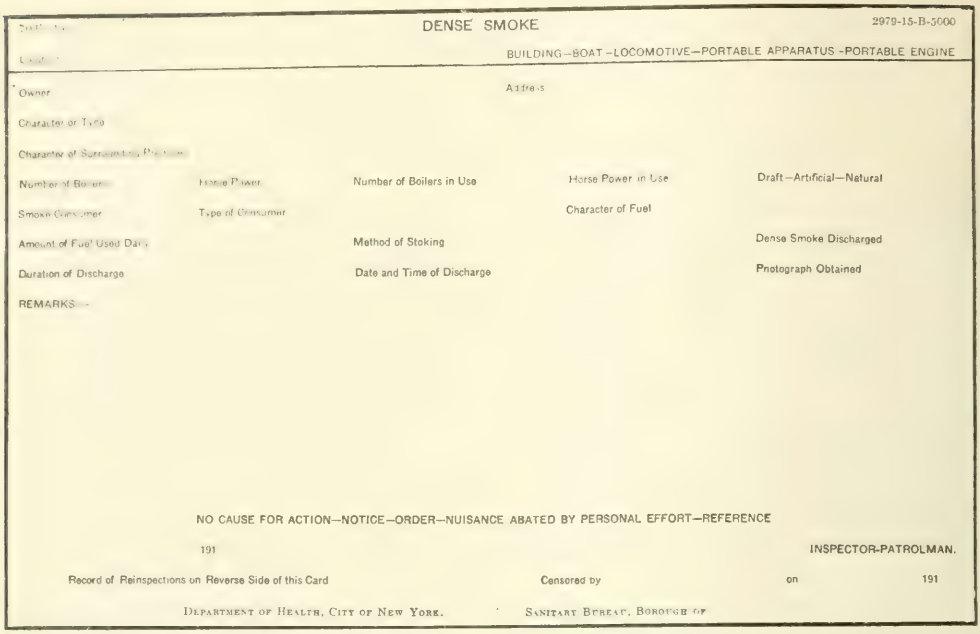
There are a large number of furnace installations properly arranged and equipped for the burning of soft coal. With these no difficulty is experienced and except in the case of an accident no dense smoke is discharged from them. On the other hand it is unfortunately true that the lack of anthracite coal of the steaming sizes resulted in the alternative of shutting down factory operation or of burning bituminous coal. *With the furnace equipment, and the method of operation based upon the burning of anthracite coal, a shift to bituminous coal generally results in a violation of the law.*

The courts have been inclined to look with leniency upon minor smoke discharges considering the coal situation. This has emboldened a number of factory operators to neglect such precautions as are generally taken for the prevention of dense smoke discharge, with the result that they have become a nuisance to their neighbors. This condition can not long continue, however, as the emission of dense smoke becomes a community proposition in a city like this, and weight of public opinion is rapidly focused on the nuisance. The moral support which follows action by the Department of Health in such cases goes far to determine the court opinion.

PROCEDURE OF THE BUREAU.

The usual procedure in this city is to have a dense smoke discharge noted by a sanitary inspector. If the density of the smoke be established as a violation and the period of emission of sufficient length to warrant further action the inspector makes an inspection of the plant itself, with especial reference to the furnace, equipment and fuel consumed. All information relative to the style of furnace in operation, the character and quantity of fuel used daily, the height of stack, the wind direction, the character of surrounding premises, the names and addresses of witnesses are obtained and recorded on a so-called smoke card.

While the inspector is at liberty to use the Ringelmann chart or the standard smoke tester, it is customary in addition, to establish the density of the smoke discharge and other relevant facts through his testimony and the testimony of witnesses. This is possibly due to



[illegible] DENSE SMOKE 2979-15-B-5000

[illegible] BUILDING—BOAT—LOCOMOTIVE—PORTABLE APPARATUS—PORTABLE ENGINE

Owner Address

Character or Type

Character of Surrounding Premises

Number of Boilers Horse Power Number of Boilers in Use Horse Power in Use Draft—Artificial—Natural

Smoke Consumer Type of Consumer Character of Fuel

Amount of Fuel Used Daily Method of Stoking Dense Smoke Discharged

Duration of Discharge Date and Time of Discharge Photograph Obtained

REMARKS—

NO CAUSE FOR ACTION—NOTICE—ORDER—NUISANCE ABATED BY PERSONAL EFFORT—REFERENCE

191 INSPECTOR-PATROLMAN.

Record of Reinspections on Reverse Side of this Card Censored by on 191

Department of Health, City of New York. Sanitary Bureau, Borough of

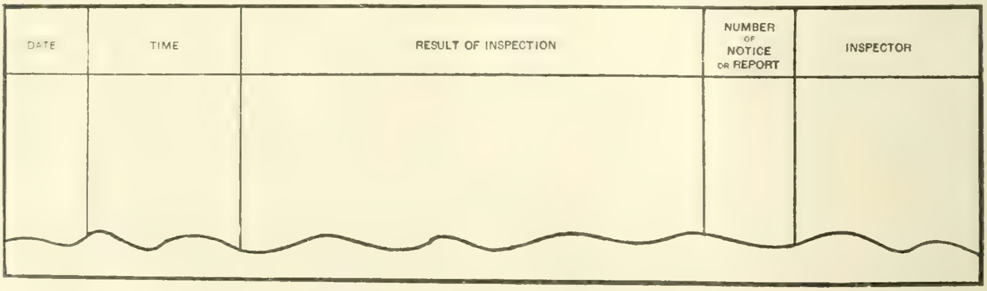
FORM OF "SMOKE CARD" USED BY SANITARY BUREAU, NEW YORK DEPARTMENT OF HEALTH.

the liberal construction placed upon the statute by court decisions.

Photographs are obtained of the stacks in question, showing the smoke discharge and additional views are secured of the conditions surrounding the plant, showing where possible the premises which are affected by the smoke.

With the establishment of the violation it is customary, except in the instance of certain persistent offenders, to serve a notice requiring that the discharge of dense smoke be discontinued forthwith. Subsequent inspections are made and if the violations continue the plant owner's attention is called to the existence of the notice, by a police officer of the sanitary squad, and the owner is warned that any further continuance of the nuisance will result in legal action by the department. If the nuisance still be unabated, the corporation counsel's office sends the owner notice of intention to start a criminal action for punishment for a misdemeanor. This is followed by legal action when necessary.

It will thus be seen that a case in court is not predicated upon one or two smoke discharges, but upon a nuisance existing for a considerable period of time. The owner of the offending plant is given every opportunity to correct any condition in his furnace operation or equipment deemed necessary and is re-



DATE	TIME	RESULT OF INSPECTION	NUMBER OF NOTICE OR REPORT	INSPECTOR

REVERSE SIDE OF "SMOKE" CARD.

peatedly warned of the result of his failure to comply.

We believe that as smoke means waste, an emission of dense smoke is an unpatriotic act upon the part of the plant owner. The national crisis into which we are plunged demands the saving of all of our resources and especially of fuel. That this is possible is no longer open to doubt. This can not be proved better than by the act of a plant owner in this city who permitted his plant to discharge dense smoke until the witnesses and photographers had started their observations of his chimney stacks. Faced with vigorous court action he corrected his methods of operation and today is running at maximum speed without the discharge of dense smoke.

A recent decision of the higher courts of this State sustaining this department in cases against boats discharging dense smoke while plying the waters of the city, has given an added impetus to smoke preventive work. As a result several of the steamboat companies have engaged specially skilled firemen to instruct their stokers in proper methods of firing. As a high percentage of dense smoke discharges are traceable to improper firing, this is a step in the right direction.

While the number of automatic stokers, etc. installed as a result of the department's campaign against the discharge of dense smoke is large, there are three plants which are now being altered to secure compliance with the ordinance, worthy of special note. These are the Brooklyn Navy Yard, the Brooklyn Rapid Transit Power House, and the Long Island City power house of the Pennsylvania Railroad.

One-half the plant at the Brooklyn Navy Yard has been equipped with underfeed stokers and orders have been placed to install this style of stoker in the balance of the plant at a cost of about $29,000. There are 72 underfeed stokers going in at the Brooklyn Rapid Transit Company's plant, and the same style of stoker, to cost about $50,000 is being furnished for the Pennsylvania Railroad power house.

Following is a summary of the department's court actions for violation of the smoke ordinance during the past three years.

Year	Arrests	Discharged	Fined	Sentence Suspended	Imprisoned	Amt. of Fines
1914	171	104	49	15	1	$1,430.
1915	258	35	161	39	2	670.
1916	78	11	41	23		504.

Discrepancy in total of results due to cases pending at end of year.

"Discharged" represents cases dropped as a result of compliance with the law.

2—PITTSBURGH.

By J. W. HENDERSON,

Chief of Bureau of Smoke Regulation, City of Pittsburgh, Pa.

In Pittsburgh the work of abating the smoke nuisance has been particularly effective during the four-year period of the present city administration which terminates with this year, 1917. Enforcement of the law is in direct charge of the Bureau of Smoke Regulation in the Department of Public Health. The work has been most interesting and particularly instructive as a study of men to us who have been new to the work of enforcing compliance to law and trying to do this impartially. It has been found that, after all, men are pretty much on a common level when their self-interest is touched in any manner, even for the general welfare of the community including themselves.

EXCUSES FOR NOT COMPLYING WITH LAW.

During this period commencing with 1914, we have been offered four reasons why the law should not be enforced. And this too, by influential, respected, intelligent and cultured men. Here they are:

1—No business.
2—Too busy.
3—Shortage of Labor.
4—War contracts.

At our last public meeting, July 26, held in the rooms of the Chamber of Commerce of Pittsburgh, these four reasons were spoken of, analyzed and shown to be the specific and direct reasons WHY THE LAW AGAINST "THE PRODUCTION AND EMISSION OF SMOKE FROM STACKS" SHOULD BE ENFORCED and complied with. Space forbids detailing our analysis of these questions. The reader can do this for himself. He has but to know that when plants are not busy is the time for improvements; that when they are busy with unfilled orders is the time to make changes that will increase production; that proper equipment will relieve labor from non-productive work, shoveling coal, etc., for use on productive effort; and that war contracts will be better taken care of as to quality and time of delivery, and that intelligent SMOKE PREVENTION ACCOMPLISHES ALL THESE DESIRABLE ENDS, to solve the questions for himself.

Our work in Pittsburgh has been productive of results due to a consistent policy of co-operation and publicity. That co-operation has been brought about mainly through public meetings with the owners and operators of stacks and public talks under the auspices of the Smoke and Dust Abatement League. The Civic Club of Allegheny County, the Chamber of Commerce and various clubs, and with ample space being given the work by the newspapers of the city.

PROSPECTIVE GAS SHORTAGE A FACTOR IN SECURING DESIRED FURNACE CHANGES.

Pittsburgh is not entirely free from smoking stacks. In fact, if all the stacks in the city were just within the limits provided in Ordinance No. 566, which allows smoke emission for about 13% of the time, the atmosphere would not be in a very desirable condition. It so happens that the effort to comply with the law brings about smokelessness that

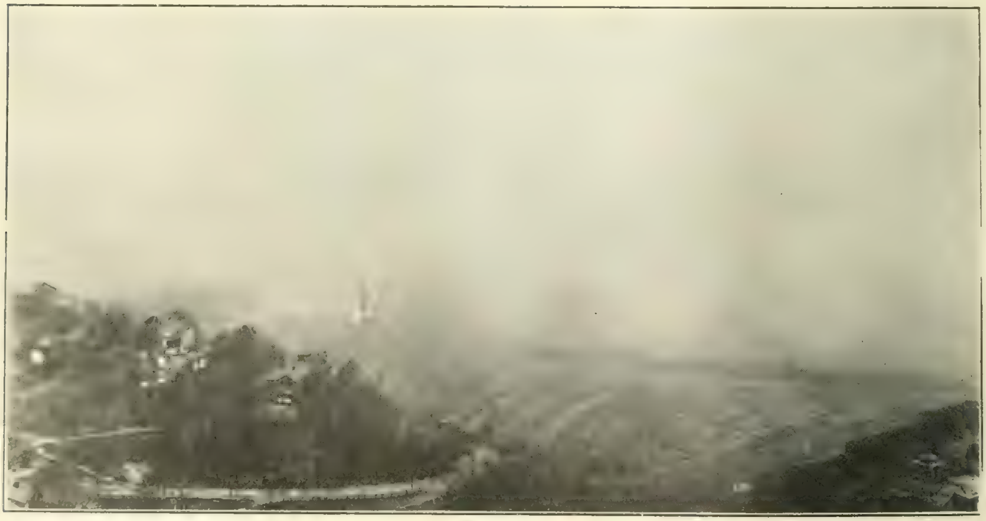


FIG 1.—VIEW OF PITTSBURGH TAKEN MAY 20, 1914, AT 11:10 A. M., ON ONE OF THE FOUR DAYS OF CONTINUOUS DENSE SMOKE.

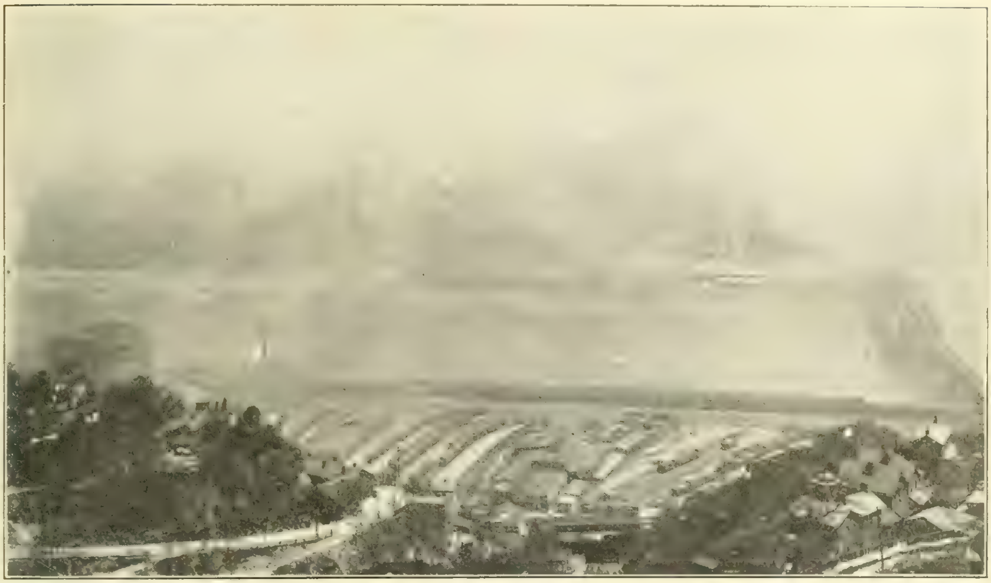


FIG. 2—ANOTHER VIEW OF PITTSBURGH TAKEN AT 11:17 A. M., MAY 20, 1914.

in many cases is practically continuous. The number of such instances and those approaching it, is increasing almost daily. The prospective gas shortage this coming winter and bringing prosecutions during June and July this year, against certain persistent violators of the law, has stimulated activity in the making of changes to furnaces and stacks, to bring them into compliance with the city ordinance. Incidentally, we can state unqualifiedly that there is not a boiler-furnace or metallurgical furnace that can not be changed so as to comply with the law and generally with profit in the way of economies and increased production.

BETTER ATMOSPHERIC CONDITIONS REPORTED BY WEATHER BUREAUS.

A witness to the progress of smoke

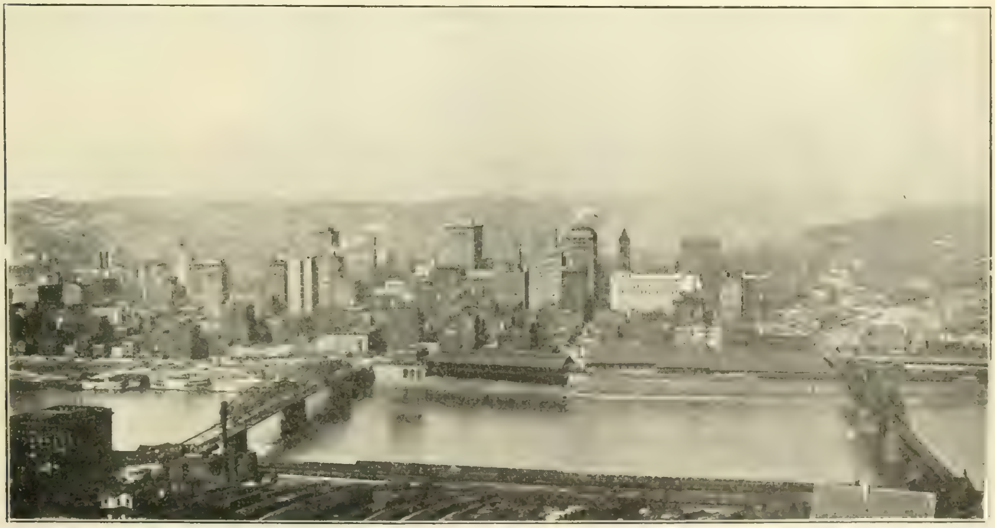


FIG. 3—PITTSBURGH UNDER PRESENT-DAY CONDITIONS.

abatement in Pittsburgh can be found in the U. S. Weather Bureau's local office which has been tabulating atmospheric conditions which it designates as "dense smoke" and "light smoke." Whenever such atmospheric conditions are present for an hour or more in any day, a record is made of the fact. The results by half yearly periods are as follows:

First six months.

	1912	1913	1914	1915	1916	1917
Dense smoke days	29	21	13	13	9	6
Light smoke days	64	64	50	46	41	44

The dense smoky days are the kind that gave the city its old title relating thereto. During May, 1914, there were four consecutive days during which the atmosphere was such as to be recorded as "dense smoke" all day long. There has not been a repetition of such occurrence since that time, notwithstanding that coal consumption has been increased fully threefold during 1916 and 1917, as compared with 1914 and during the previous years. It is also noteworthy to state that whenever the humidity is high and the wind velocity low, the conditions are right for producing an atmospheric condition such as is recorded by the weather bureau.

When that has been the case during the past three years, the number of hours of duration has been lessening so that almost invariably the atmosphere is cleared up before ten o'clock in the morning. The wide publicity given this change that has taken place in our city, has attracted inquiries about it from all over this country, Canada and from England, Australia, India and Japan. Evidently, only a continuance of the policy of absolute impartiality in all cases, will maintain the progress made and continue the good work.

The smoke nuisance is a continental problem that can not be separated from the questions as to public health, labor shortage, the progress of the war and the conservation of the natural resources of the country, for war purposes and for the general welfare after peace shall be declared. The United States Government should add smoke regulation to its program of activities. The work is of too much importance to leave to the changing policies of city, county and State governments.

The question has been brought to the attention of a member of the President's cabinet and to some members of Congress. Anybody can make smoke. The problem is to be able to make it when there is some definite purpose in view and *then* not to have it pouring from stacks when it not only is not performing any useful function, but is representing a distinct loss to all the people. Will the United States Government undertake the task?

3—CINCINNATI.

By WALTER M. SQUIRES

Superintendent of The Smoke Abatement League of Cincinnati, O.

Of the many and vital problems confronting every city, whether it be large of small, the problem of smoke abatement is rapidly assuming a place in the front rank.

Cincinnati, founded in 1788, began using soft coal at once in her dwellings and factories. As years passed the smoke evil became greater and was more clearly recognized but it remained for an agitation begun by the ladies of the city, headed by the late Dr. Julia L. Carpenter, to secure our first anti-smoke ordinance, which was passed in November, 1881. With the exception of Chicago, we were the first great American city to take such action. Even then it was a dead letter for a quarter of a century and things got to such a pass that public opinion demanded that something be done. The

Smoke Abatement League, organized in 1906, was the result.

The Smoke Abatement League of Cincinnati, as an organization, is, undoubtedly, one of the most unique institutions of its kind in the country. Though wholly without endowment and deriving no revenue whatever excepting from voluntary contributions, it has never borrowed a dollar at the bank or given a note; has no debts; but collects from the public in advance sufficient funds to meet its needs. Annual dues are only $5.00 and many of our leading physicians, attorneys, business men, firms and manufacturers are members. Its staff of inspectors is composed of men all trained in the theory and practice of smoke abatement, capable not only of making observations but also to visit power plants and instruct the firemen as to the proper method of operating his furnace and also, when found necessary, to diagnose the furnace conditions and give suitable recommendations for alterations in their design.

LEAGUE WORKS WITH CITY SMOKE INSPECTION DEPARTMENT.

A thorough spirit of harmony and co-operation exists between the league and the city smoke inspection department. This does not only exist in theory but also in practice. The city has been divided into districts, one of which is supervised almost exclusively by the league, and practically all smoke abatement work in this district is left to its discretion. The office is established on the 29th floor of the Union Central Building and it is possible to make observations for the entire basin of the city from this point.

When a stack is seen smoking excessively the plant is immediately notified by telephone and the responsible party cautioned. This has been a great aid in breaking up carelessness on the part of the operators, for they soon became aware that they are under almost constant supervision. However, when this fails or satisfactory results are not secured, the plant is visited and a determination made as to the cause of the smoke. If the operator is at fault, he is again cautioned and advised that another repetition of the offense will mean court action. If it is determined, however, that he could not avoid making the violation owing to faulty design of or obsolete furnaces, the owner is called into consultation and requested to make such changes as are deemed necessary and a reasonable length of time is granted him to make them. The owners have found that the changes they have been required to make have not worked a hardship upon them, but instead, in nearly every case, have been a source of revenue through lessened fuel bills, often to such an extent that the money expended in making changes has been speedily returned. Frequently solicitations for assistance are made to us.

Court action is used only as a last resort or when all other methods fail. Co-operation is the keystone upon which any success we may have had is laid. That the smoke inspection forces are securing results in their efforts to rid the city of the smoke nuisance is evident from the fact that within the last four years fully 75% of the smoke from the factory, power and office buildings and locomotives has been abated.

During the winter months there is still a great deal of smoke from old, obsolete equipment which, apparently, can not be prevented except by the complete removal of said equipment from service and replacement with the new smokeless types of furnaces that are now available. The league is at present engaged in this work and is hopeful of success.

The Economical Purchase and Use of Soft Coal for Heating Homes

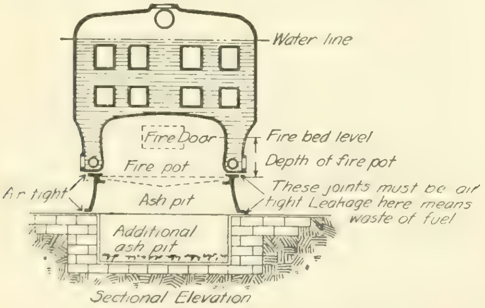
A timely circular on the purchase and use of soft coal for house heating purposes has recently been compiled by the Engineering Experiment Station of the University of Illinois. Among other things, the more important factors involved in the installation of a satisfactory and economical house-heating system are discussed, and the most economical methods of firing soft coal and operating a house-heating plant are presented. For the convenience of the house-holder who desires to place his heating system in proper condition to derive the benefits of great economy from its operation, the most vital installation and operating requirements are summarized.

The order in which the several phases of the subject are discussed corresponds with that in which the householder normally considers them. In the early summer he looks over his heating system to see that it is in proper condition for the next heating season; next he purchases his coal; finally he is concerned with the problem of operating the system in a manner which will produce the best results.

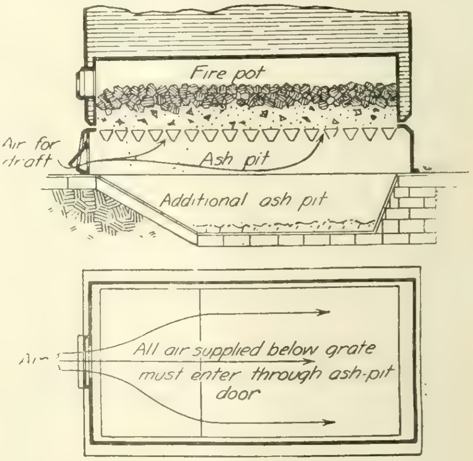
The information contained in the circular was compiled under the direction of a committee of which A. C. Willard, assistant professor of Heating and Ventilation at the university, was chairman.

After discussing the requirements to be met by a satisfactory house-heating installation, as shown in Figs. 1, 2 and 3, the circular takes up the arrangement of heaters for burning soft coal. Soft coals, it is stated, which swell when heated and also coke, which is more bulky than coal, require larger fire boxes to permit a sufficient amount of fuel to be fired to last between reasonable firing periods. Fire-pots for soft coal, in many types of heaters, especially warm-air furnaces, are slotted (Fig. 4) or have a special air supply ring (Fig. 4) at the surface of the fire to introduce heated air, and thus to provide for more nearly complete combustion of the gases which come from such coal.

Down draft, cast-iron and steel heating boilers (Fig. 5) are now manufactured, and are used in large residences and apartment houses for burning soft coal without smoke, or with reduced quantities of smoke. In these boilers air is supplied *from above* to the fuel, which is burned on a grate composed of hollow bars or tubes containing water. This grate is so placed (Fig. 5), just above an ordinary direct-draft grate, that the volatile gases from the freshly-fired fuel



Sectional Elevation


Fire pot
Air for draft
Ash pit
Additional ash pit
Air
All air supplied below grate must enter through ash-pit door

Longitudinal Section Showing large capacity of additional ash pit

FIG. 1—APPROVED METHOD OF SETTING STEAM AND HOT WATER BOILERS TO PROVIDE ADDITIONAL ASH PIT.

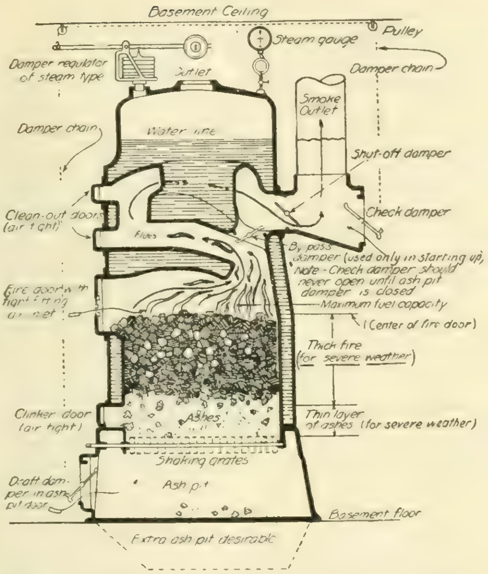

Basement Ceiling
Pulley
Steam gauge
Damper regulator of steam type
Outlet
Damper chain
Smoke Outlet
Damper chain
Water line
Shut-off damper
Clean-out doors (air tight)
Check damper
Flues
By pass damper (used only in starting up)
Note - Check damper should never open until ash pit damper is closed
Fire door with tight fitting air inlet
Maximum fuel capacity
(Center of fire door)
Thick fire (for severe weather)
Clinker door (air tight)
Ashes
Thin layer of ashes (for severe weather)
Shaking grates
Draft damper in ash pit door
Ash pit
Basement floor
Extra ash pit desirable

FIG. 2—TYPICAL STEAM BOILER, SHOWING NECESSARY DAMPERS AND DOORS.

on the upper grate *pass down* over the hot surface of the thinner well-coked fire which is kept brightly burning on the lower grate. The fire on this secondary or lower-grate fire acts, in the presence of sufficient air, to ignite and burn the volatile smoke-producing gases and sooty products which would otherwise pass through the flues of the boiler and up the chimney unburned.

In this way, not only are the actual smoke-forming products consumed when the furnace is under proper regulation, but all the other burnable gases are completely consumed in the boiler itself, so that more heat per pound of fuel is made available for heating the building.

HINTS ON CHIMNEY CONSTRUCTION.

The circular has some good hints on chimney construction. The use of fire-clay flue-lining throughout the length of the chimney is recommended, both on account of tightness in connection with air leakage but also as reducing the risk of fire in the chimney.

Covering for warm-air pipes, as well as for steam and hot water piping is recommended. For air, a 3-ply asbestos

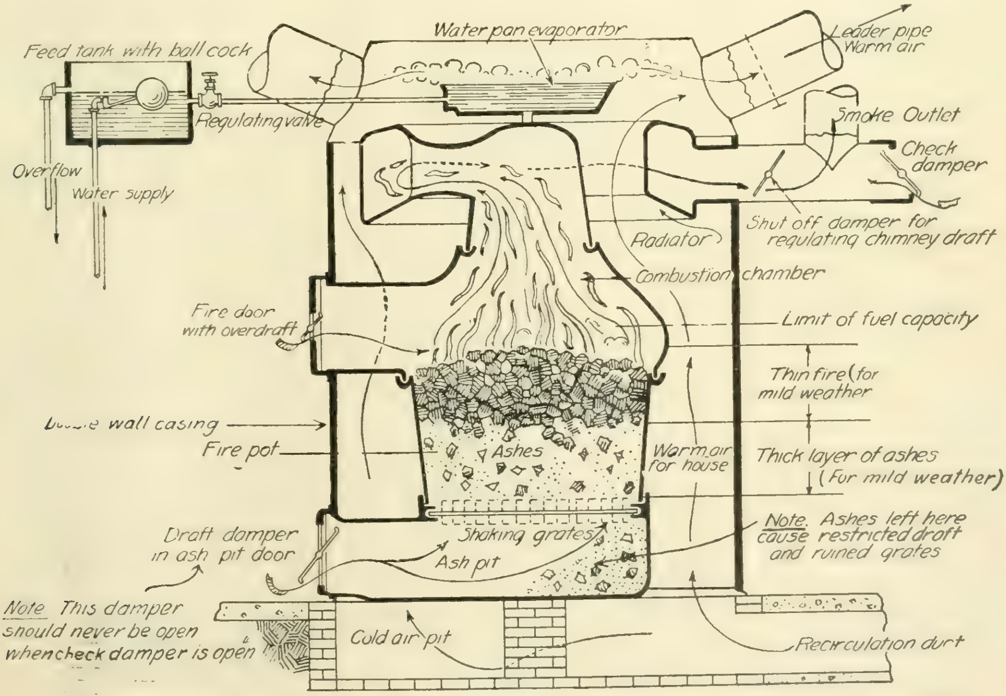


FIG. 3—TYPICAL WARM-AIR FURNACE, SHOWING DOORS AND DAMPERS FOR PROPER REGULATION.

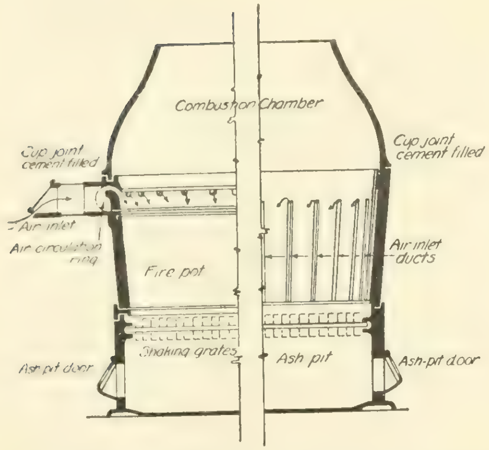


FIG. 4- TWO TYPES OF FIRE POTS FOR BURNING SOFT COAL WITH AIR SUPPLIED ABOVE THE FUEL BED.

paper covering at least ¼ in. and preferably ½ in. in thickness is desirable.

Recirculation of air in warm-air furnace systems is endorsed by the committee. The recirculating duct, taking air from the front hall, instead of from out-of-doors, must be large and practically equal in size to the combined area of the warm-air leaders coming from the furnace.

THE HUMIDIFYING REQUIREMENTS.

For supplying the necessary amount of moisture to the air, it is recommended that warm-air furnace systems be equipped with an evaporating tank or pan placed above the dome and just beneath the bonnet of the furnace where "it will receive heat enough to evaporate sufficient water effectively to humidify the air going to the rooms." An automatic ball-cock or feed-valve should be arranged in an external float-tank to keep the evaporating pan constantly supplied with water. A hand-control valve is needed on the line supplying the evaporator, and an overflow should be run from the float-tank. In very cold weather, with the furnace running at full capacity, the hand-control valve must be partially closed at times; otherwise too much water vapor will be sent into the house and the windows will become covered with frost. "The average water pan placed near the bottom of the jacket of warm-air furnaces," says the report "is ineffective as a means of humidifying the air in a house."

As regards the equipment of steam and hot water heating plants with humidifying apparatus, it is stated that a satisfactory humidifying system is a more expensive item than in warm-air furnace heating. Water pans on radiators are not generally capable of supplying sufficient vapor to be of any real value. This deficiency is especially true in the case of hot-water systems, in which the radiator temperatures are lower than in a steam

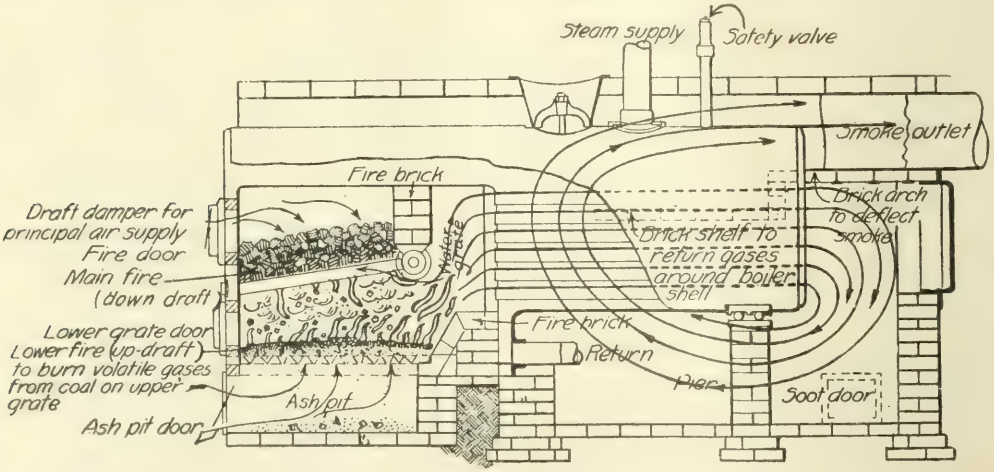

Steam supply
Safety valve
Smoke outlet
Fire brick
Draft damper for principal air supply
Fire door
Main fire (down draft)
Lower grate door
Lower fire (up-draft) to burn volatile gases from coal on upper grate
Ash pit door
Ash pit
Water grate
Brick arch to deflect smoke
Brick shelf to return gases around boiler shell
Fire brick
Return
Pier
Soot door

FIG. 5—TYPICAL DOWN-DRAFT BOILER FOR BURNING COAL WITHOUT SMOKE.

system. With a steam plant special valves or cocks may be connected into the steam pipes or radiators and may be used to "bleed" or supply steam direct from the system to the air of the room. This can be accomplished quietly, and if the valves are regulated in accordance with fluctuations in the outside temperature so as not to admit an excess of vapor, frosting of the windows can be prevented and a proper air condition maintained.

There is no simple and effective way of humidifying the air with a hot-water system. Recourse may be had to a large pan of water kept simmering on the kitchen stove with doors between rooms left open as a partial solution of the problem.

THE PURCHASE OF COAL.

Among factors to be considered in the purchase of coal, attention is called to the fact that many users of large amounts of fuel buy their coal on the heat unit basis. It is pointed out that the case with the householder is slightly different from that of the large user. While the heat value of a coal is still the most important thing to be considered, other characteristics and factors have a relatively greater bearing upon the problem of the householder than upon that of the large user. The value of a fuel in a house heater is not dependent entirely upon its B. T. U. value, but to a considerable extent upon the skill of the fireman, the design of the furnace, the method of firing, and the several properties of the coal. For example, careful firing and attention will yield as good results with an 11,000 B. T. U. coal as indifferent methods of firing will produce with a 12,000 B. T. U. coal. Widely different varieties of coal should not be compared solely on the basis of their heating value. The greater convenience in handling and firing, lack of smoke and dirt, and the method of burning are all qualities which distinguish, for instance, the eastern coals from the Illinois coals and make them more desirable. How great a difference in price the householder is justified in paying for these advantages is, of course, a matter of the individual to decide for himself.

With reference to the selection of dif-

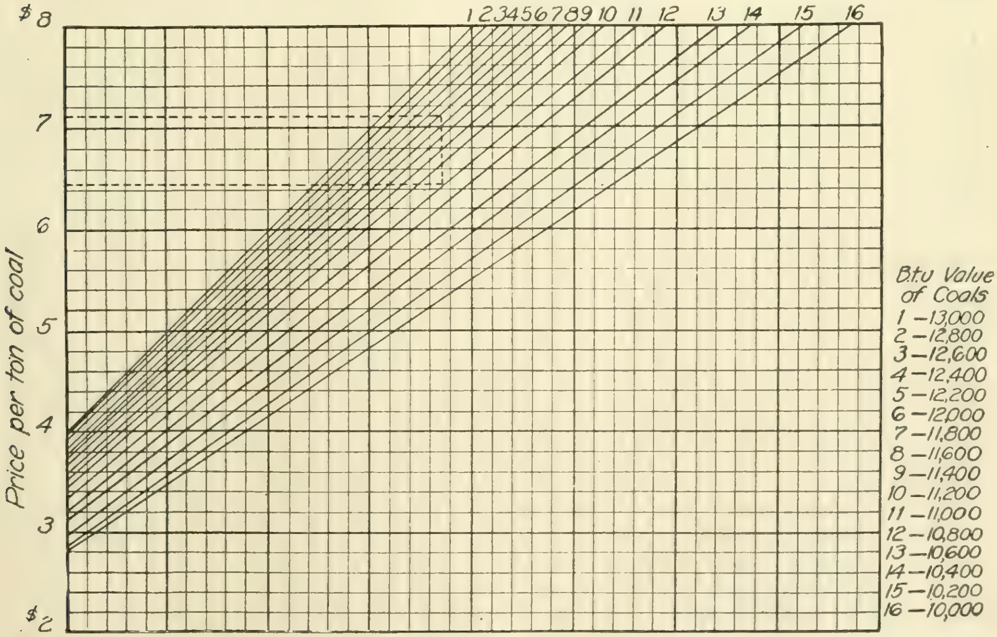


FIG. 6—THEORETICAL VALUE OF COALS OF DIFFERENT HEATING VALUES AT VARIOUS PRICES PER TON.

ferent Illinois coals, the B. T. U. value and the percentage of ash furnish a general guide to their relative values. The ash content directly affects the B. T. U. value, so that the relative value may be expressed with fair accuracy by the B. T. U. value alone, although the efficiency of any coal drops off more rapidly than its B. T. U. value when the ash content exceeds 10% or 15%.

In order to enable the small consumer to judge as to the relative values of coals offered at different prices, the chart, Fig. 6, has been prepared to show the theoretical value of coals of different heating or B. T. U. values at various prices per ton. A close approximation of the percentage of actual heat-producing material in Illinois coal may be obtained by dividing the B. T. U. value of the coal by 155. Thus, a 12,000 B. T. U. coal contains 12,000 ÷ 155, or 77% of heat-producing material.

The householder should remember that the B. T. U. value, as shown by the test of a selected lump or properly-taken mine sample does not necessarily coincide with the B. T. U. value of the coal as delivered. Ordinarily, the heat value of well-prepared coal purchased from reputable dealers does not vary more than 4% or 5% from the analysis of the mine sample. Advertised values based on "selected" samples may, however, prove misleading. Unscrupulous dealers sometimes takes advantage of the householder's lack of technical knowledge and deliver poorly-prepared or improperly-sized coal which may be greatly deficient in heating value. The precautions which a householder may take against such a risk are: (*a*) buy from dealers who are known to be reputable and responsible, (*b*) examine the coal to see that it is free of impurities and is properly sized, (*c*) in an extreme case, in which the quality of the coal seems to have been grossly misrepresented, have a sample taken and analyzed by a qualified fuel chemist who understands the correct method of sampling.

DRAFT CONTROL FOR ILLINOIS COAL.

In order to operate any system of heater drafts successfully, especially with Illinois soft coal with which the circular is chiefly concerned, certain fundamental facts must be understood.

Due to the suction or draft action produced by a good chimney there is a constant tendency for air to enter any opening into the ash pit, combustion chamber, or smoke pipe of a house heater. It is, therefore, necessary to have all such openings controlled by tight-fitting dampers.

Air must be supplied in varying quantities, ranging through wide limits, in order to burn the fuel economically. With Illinois coal this variation in amount of air required is large and requires careful attention. It is greatest soon after firing, from which time it should be gradually decreased until the next charge is fired.

Air may be supplied either above (through fire door, Fig. 3 or through special slots or ports) or *below* (through ash pit door—Fig. 3) the burning fuel bed, and sometimes both above and below the bed. Immediately after firing soft coal, when the most air is needed, some air must enter above the fuel bed in order to burn the large amount of volatile matter given off from the fresh or "green" fuel charge and to provide sufficient oxygen to insure the burning of the combustible carbon gases given off from the fuel bed. Failure to supply air for this purpose will result in a considerable loss or waste of heat. As soon as this gaseous matter is burned off (the fresh fuel will have become more or less bright on top by this time) the over-draft through the fire door should be partly closed and the ash-pit damper left partly open. In mild weather, both the ash-pit damper and the overdraft should be closed to prevent the coked fuel now left in the fire from burning out too quickly.

In case the fire must be checked still further, as is true for most of the heat-

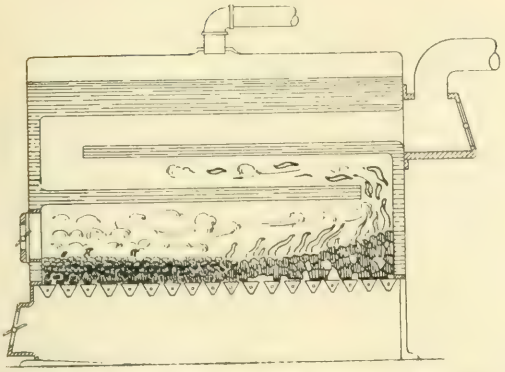


FIG. 7—FIRST STAGE OF COKING METHOD OF FIRING.

ing season, the check damper (Fig. 3) in the smoke pipe must be opened in order to decrease the draft or suction action of the chimney by admitting cold air directly into the flue. This is the case when the fire is to be carried overnight without burning out, but there should be no attempt to "hold" a fire in this way unless there is a good bed of fairly well coked fuel already in the fire pot. Always let a fresh fuel charge burn up somewhat, with overdrafts at fire level open, before attempting to carry it for a considerable period with an open check-damper.

In order to promote economy, fire at fairly regular intervals, and put on comparitively small charges of coal frequently rather than large charges at much longer intervals. It is recognized that infrequent firing of large quantities of coal may be the more convenient method, but such convenience can, with the ordinary heater, be obtained only at the sacrifice of economy. Large charges of coal and infrequent firing will increase the chimney losses due to the production of unburned gases just after firing.

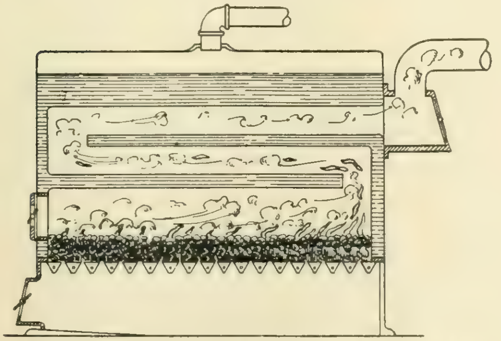


FIG. 8—SECOND STAGE OF COKING METHOD OF FIRING, WITH NEWLY-COKED FUEL SPREAD OVER ENTIRE FUEL BED.

Employ the coking method of firing (Figs. 7 and 8) in so far as possible that is, spread the fresh coal upon a portion of the fire bed only, leaving a portion of the fire glowing brightly (Fig. 7) so that the gases which rise from the freshly-fired coal may be quickly ignited. As soon as the fresh coal has been coked it should be spread out over the entire fuel bed (Fig. 8). It will then burn as a bright fire without further smoke (Fig. 9).

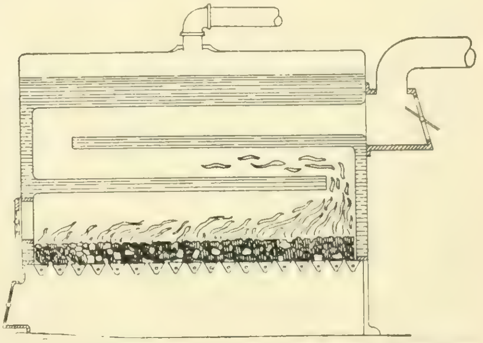


FIG. 9—THIRD STAGE OF COKING METHOD WITH ENTIRE FUEL BED INCANDESCENT.

Those heaters which have fire-pots sufficiently large to permit the effective use of the coking method of firing by depositing considerable quantities of coal on one part of the fire bed while the other is glowing and carrying on the combustion can be most economically employed for house heating. Many house heaters have fire-pots which are too small to make possible the use of the coking method and its economy.

Keep a fairly thick fire bed, with the surface of the fire well up in the heater. This keeps the fire in the best condition to radiate heat to the heat-absorbing surfaces and prevents the loss of coal to the ash pit. More ashes can, of course, be carried in the lower part of the fuel bed (Fig. 3) during mild than during cold weather. Do not poke or stir the fire as this is likely to produce clinkers and to cause greater losses both to the ash pit and to the chimney. For the same reason excessive shaking should be avoided. If clinkers are produced, they should be removed with as little disturbance of the fire bed as possible. Keep the ashes away from the under side of the grate. Their presence may prevent the inflow of sufficient air, or may deflect the air admitted through a part of the fire bed only. This condition not only interfers with the proper combustion of the coal, but may also result in burned-out grates.

CARE OF THE HEATER IN SERVICE.

The heater while in service should be kept in good repair throughout. Soot and ashes in the flues or gas passages prevent the heat from passing to the water, steam or air which is to be heated. Flues should be thoroughly cleaned at regular intervals. Some heaters should be cleaned every day, while in general a cleaning about once a week is sufficient. Soot and ashes upon the heating surfaces not only prevent the passage of heat, but may so clog the flues as to interfere with the draft action and thus make satisfactory operation of the heater impossible.

WHY SMOKE IS AN INDICATION OF LOSSES.

While tests have shown that the actual heat value contained in smoky discharges from the chimney is not very much greater than that contained in discharges which are not smoky, the presence of smoke usually indicates careless methods of firing or improper regulation of dampers with their attendant losses and wastes. If your chimney smokes continually or too freely, you may be sure that unnecessary losses are taking place.

Civic Phases of the Smoke Problem

By JOHN J. O'CONNOR, JR.,

Assistant Director Mellon Institute of Industrial Research University of Pittsburgh.

The problems of modern cities are largely industrial problems. Ancient cities were founded around religious, political or trading centers; modern cities were founded at points where raw materials could be secured or easily assembled for the making of goods. If cities have failed to solve their problems it is not so much the fault of theories of government, as it is that industry has failed in service.

The industrial life and with it, of course, the very existence of a great many of our cities is predicated on coal consumption. It is, therefore, not in the least surprising that cities have found great difficulty in solving a problem which arises out of coal consumption—the smoke problem.

Nevertheless, American cities have long recognized the existence of the problem and have attempted to cope with it. As early as 1804 the burgesses of Pittsburgh called the attention of the borough council to the smoke evil. It was not until 1881 that cities made the smoke nuisance a subject of legislation. Chicago passed the first general ordinance in April of that year and Cincinnati the following November. Legislative enactments have gone on until now all cities which burn large quantities of bituminous coal for industrial purposes have smoke abatement ordinances. The enactment of so many ordinances may indicate a widespread, live interest in the smoke problem, or it may point to a surpassing faith in the power of legislation.

THE SMOKE NUISANCE HAS BECOME A COMMUNITY PROBLEM.

At all events, the concept of the smoke problem has changed. That is the important and hopeful sign. That which was a nuisance and the abatement of which was to be secured by the establishment of facts in each individual case has become the smoke nuisance—a community problem. The establishment which now makes objectionable smoke is not looked upon as causing injury or annoyance only to the individual who happens to live next door to it, but to the whole community. Therefore, when the smoke inspector proceeds against the violator of the ordinance he is doing so not on behalf of either a cranky, pesky, irrational or jealous individual, but on behalf of the community.

Another way of expressing this new concept is by saying that more and more emphasis is being placed on a "diffused smoke nuisance"—a whole city enveloped in smoke—as distinct from a "local smoke nuisance"—a single or a few stacks in the same vicinity pouring out smoke.

SMOKE PREVENTION SAVES 20% OF THE HEAT VALUE OF FUEL.

This new concept has been formed because cities are having it impressed upon them and are beginning to realize that the smoke nuisance is a serious obstacle to any kind of city planning, that it destroys building materials, retards the growth of vegetation, cuts off sunlight and daylight, prolongs fogs, is injurious to comfort and harmful to health, and is costly both to the smoke maker and to the public. The last point in the indictment of the smoke nuisance —that it is costly both to the smoke maker and to the public—is one which should be thoroughly understood, for very often persons in favor of smoke abatement are accused, as it were, of placing explosives beneath the foundation of industry. The bituminous coal consumption of this country is something over 400,000,000 tons which is valued at least at $800,000,000. It is conservatively estimated that 20% of this coal consumption goes up the chimney as tribute to "King Smoke." This means a loss of about $160,000,000 annually.

That is not all. On the basis of the average cost of the smoke nuisance for cities, in which estimates have been made, the annual cost to the people who live in what the United States census terms "urban territory" is about $550,-000,000. Cities have every reasons to relieve their citizens of the burden of this tax.

Again, city assessors and the courts have taken cognizance of the fact that the smoke nuisance reduces rents, increases the difficulty in letting houses and decreases the selling price of properties, especially in residential sections.

INDUSTRIES NOT DRIVEN AWAY BY SMOKE LAWS.

There is another point on the economic side. It refers to the old cry about driving out business. This cry is often raised when some offenders are hard pressed. It it then asserted that if the smoke ordinance is enforced, manufacturing plants will be compelled to move elsewhere. There is no evidence to support this threat. On the contrary, there is abundant proof that the smoke condition of the atmosphere keeps certain very desirable industries from locating in smoky cities and, in the second place, it imposes a heavy tax on industries already located in such cities.

A consideration of these points leads to the conclusion that the abatement of the smoke nuisance, unlike many other social nuisances, against which outcry has been made, would result in direct and immediate gain both to the public at large and to those who are chiefly responsible for it.

Cities of this country are doing much to solve the smoke problem, but the citizens have every reason to demand and to bring pressure to bear that the process be accelerated because of health, welfare, comfort and the things which make for civic betterment.

THREE WAYS TO MAKE SMOKE PREVENTION WORK MORE EFFECTIVE.

It may not be out of place at this point to make three suggestions as to how this acceleration may be brought about:

The first one is that a city administration should take an active interest in the smoke problem. It is not outside of its duty nor beneath its dignity to do so. The interest should take the form of constructive suggestion and encouragement, not a contemptuous tolerance of the bureau, pernicious interference on behalf of favorite offenders or the sending out of the edict "go easy." Any municipal activity breaks down at the point where favoritism enters. Unfortunately it is sometimes true that the smoke inspector does not secure more co-operation from the city administration because he, himself, does not take the proper attitude on the smoke problem. He often thinks that his is somehow a hopeless and thankless job and the best he can do is to let "bad enough" alone. The smoke problem calls for broad men, men who have a sound fundamental training, men of imagination and men of force.

The second suggestion is that a city should know what its problem is. This may sound foolish, but there are not more than two cities in this country which have the information on which to base a serious campaign against the smoke nuisance. A city should know what its coal consumption is and its relation to the smoke problem. It should have exact knowledge as to the general sources of smoke and a good idea of the amount of smoke made by each source. It should know the location of all stacks and have all significant data on the kinds of installation under them. It should place special emphasis on securing facts as to the ability of the different installations to abate smoke. It should spare no expense to secure evidence with which to convince the most hardened offender of the smoke ordinance that the emission of dense smoke is both wasteful and harmful.

The third suggestion is that with such information a city should diagnose its problem and plan broadly and deeply for its solution. For this purpose the ordinance should be studied to find out whether or not it was simply copied from that of another city or was adapted to the problem at hand. It should decide how much emphasis is to be placed on the abatement of smoke and how much on the prevention of future smoke. The organization of the smoke department should be worked out with reference to the extent and nature of the problem. If it is possible, the smoke bureau should be separated from other activities and set off by itself. This will give to it dignity, obtain for it the proper attention and concentrate responsibility.

Above all, plans should be laid to secure the co-operation of all civic and commercial organizations and institutions of learning that a solid front may be presented in attacking the smoke problem. This is important, whether the plan of procedure is to be one of education or prosecution. No municipal activity in this country is developed sufficiently to reach its goal without the help of organizations which have the welfare of the community at heart. The assistance, the criticism and the approval of civic organizations should be sought after and prized. Institutions of learning in which reside the sciences which have solved so many municipal problems should be recruited for the fight, and the students of engineering schools should be impressed with the necessity of giving attention to problems of combustion. All the forces that are in a community should be called into action to help to solve one of the most difficult problems which confront municipalities.

To summarize: Most of our civic problems are problems of industry—problems concerned with our very existence. The smoke problem is such a one, and for that reason, if for no other, is difficult to solve. Cities are coming to take an increased interest in it. This is due to the fact that points in the indictment of the smoke nuisance have been impressed upon them with new force. Cities have come to know that the smoke nuisance is harmful and wasteful, and that smoke abatement is practicable. Cities with well-organized smoke abatement departments which have the support and interest of city administrations, cities which know the problem before them and which have planned broadly and deeply for its solution have every reason to look forward to "Noble and joyous cities, unbelievably white."

Important Points to Consider in Using Soft Coal

By C. B. THOMPSON,

President of The Thompson Heater Corporation.

Fuel economy is being forced on the American people by the constantly advancing price for all kinds of fuel. At the present time, war conditions have unsettled prices of almost every commodity, including the various fuels; but when conditions are normal, soft coal is the cheapest fuel on this continent. It occurs in almost every State and territory, while hard coal is limited to a comparatively small area of *one state only*.

The comparative prices of soft and hard coals vary for different localities. In some States soft coal sells for about half the price of hard coal. In other States the price asked for one ton of hard coal will buy three or four tons of the local soft coal.

RELATIVE HEATING VALUES OF HARD AND SOFT COAL.

The relative heating values of hard and soft coal are not well understood by the general public. The majority of the people believe that for heating purposes two and one-half to three tons of hard coal are equal to five tons of soft coal. Then again, many coal buyers are under the impression that the coal showing by analysis the highest heat content is the most valuable coal for any kind of heating purpose.

Now, in fact, neither of the foregoing suppositions is correct. Although the United States Government has analyzed a great many varieties of coal, both soft and hard, and given the same to the public through official bulletins, yet in none of those bulletins can the user find any data that will indicate the burning characteristics of soft coal.

If we are selecting a hard coal by analysis we try to get a coal with a high heat content and a low ash. But when it comes to selecting soft coals by analysis, the problem is more complicated.

BEST GRADES OF SOFT COAL LIKELY TO CAKE.

If we select for heating purposes a soft coal of the highest calorific power or heat content and low ash, we are likely to have a hard caking coal that fuses and makes into a hard mass, making the stoking a difficult and disagreeable task.

In some types of boilers this hard caking variety will be almost unburnable. The heat content of the eastern soft coal equals, and for some varieties exceeds the proximate analyses of the best hard coal. The western soft coals run from 10% to 20% lower in heat content than is found in eastern soft coals.

Notwithstanding this, the western soft coals are better adapted for burning in down-draft and special soft coal boilers than are the eastern coals. This is so because many of the western coals are semi-caking; that is, the coal does not fuse and run together under heat as readily or bake so hard as do some of the eastern coals, and for this reason less stoking is necessary. In burning soft coal in up-draft boilers the caking coal is preferable for the reason that the coal fuses at comparatively low temperatures, forming a crust in the upper fuel mass which prevents the escape of the volatile gas. This gas is thus forced to the sides of the firepot, where it forms an intimate mixture with the oxygen, ignites and becomes useful heat.

When free-burning or semi-caking coal is burned in up-draft boilers the volatile gases which constitute from 30% to 40% of the total heat content escape through the upper strata of coal unignited and become a total heat loss.

In boilers especially designed to burn soft coals these volatile gases burn to useful heat, and for this reason a semi-caking coal is better adapted for burning in the modern soft coal boiler than are the strong caking varieties.

In selecting soft coal to burn in specially-designed soft coal boilers it is advisable to select one with a high volatile gas content, as this item indicates a free-burning or semi-caking coal. The heat content of a typical western coal will run about as follows:

Volatile matter	39.65
Fixed carbon	49.86
Ash	8.72
B.T.U. per lb.	12,000

A typical eastern soft coal will analyze about as follows:

Volatile matter	24.7
Fixed carbon	68.3
Ash	5.95
B.T.U. per lb.	14,280

The so-called smokeless coals are low in volatile matter, about 16% being a fair average, and, as is well known, these coals require a great deal of stoking because of their strong caking qualities. A very free burning coal is mined in Ohio which burns as freely as charcoal. The volatile gas content in this coal runs about 46%.

Broadly speaking, the difference in the cost of heating with soft coal as against hard coal is the difference in the cost per ton. The exceptions are for the lignite and sub-bituminous which are low in heat content.

There are many who object to using soft coal, for various reasons, but chiefly because of the smoke and soot accumulations. A properly-constructed soft coal boiler will eliminate these two objections.

WHY PEA COAL SAVES MORE THAN THE DIFFERENCE IN PRICE.

A valuable hard coal product is pea coal when burned in boilers specially constructed for same. While pea coal at the present time costs within a dollar of the price of stove coal, yet where it is burned in place of stove coal the saving is very much greater than is indicated by the difference in price. This is so because in practice *90% of fuel waste is due to burning fuel in excess of requirements.* When pea coal is burned its density prevents runaway fires, and for this reason it is an excellent draft stabilizer.

There are many instances on record where the change from stove coal burned in an up-draft boiler to pea coal burned in a specially-designed magazine boiler has effected savings as high as 40%, while the difference in price of the two sizes does not represent at the present time more than 15% or 20%.

Pea coal is easily and cleanly handled, and when burned in the right kind of boiler there is no clinker. It is too dense to burn in up-draft boilers unless mixed with a coarser coal or with broken coke.

Practical Notes on Chimneys and Draft

By W. A. PITTSFORD,
Engineer, Kewanee Boiler Company.

The accompanying illustrations and data are taken from practical notes on chimney construction and draft troubles. Referring to Fig. 1, it will be seen that there will be trouble with the draft on the building in the lower left-hand corner, when the wind currents are from certain directions, and if the surrounding conditions are such to make buildings of this character necessary, provisions must be made to overcome the downward pressure on this chimney of the lower buildings, when the wind is from the higher point.

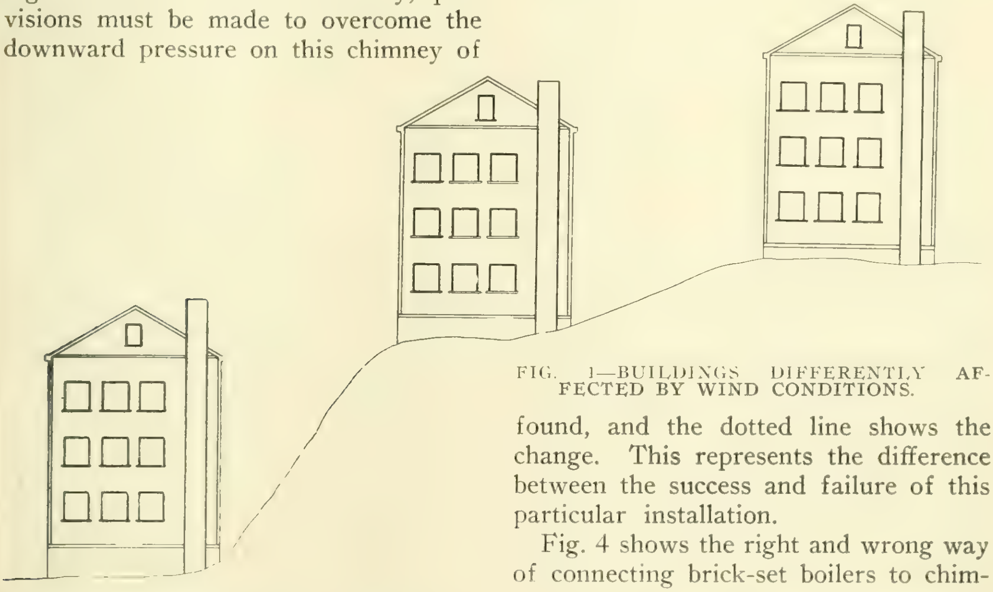


FIG. 1—BUILDINGS DIFFERENTLY AFFECTED BY WIND CONDITIONS.

Fig. 2 is a representation of a series of tests on a chimney and is very accurate, showing the velocities at different points in the chimney, which is a hexagon shape and 110 ft. high. Compared with chimneys of the same area, round or square, the difference is so slight that it is scarcely noticeable, and is shown for the purpose of recommending that if a stack has the height and area, its shape is not a feature to condemn the chimney. Of course, a round chimney is preferable in all cases, but is not absolutely necessary. However, height and area are absolutely necessary. Breechings and breeching connections are sources of more trouble than any other one thing in a heating plant. Of course, boilers that are not brick-set usually have a fixed damper opening, and are usually free from the troubles that the brick-set boiler is heir to.

Fig. 3 is a reproduction of an actual occurrence and the changes made. The heavy line shows the conditions as found, and the dotted line shows the change. This represents the difference between the success and failure of this particular installation.

Fig. 4 shows the right and wrong way of connecting brick-set boilers to chim-

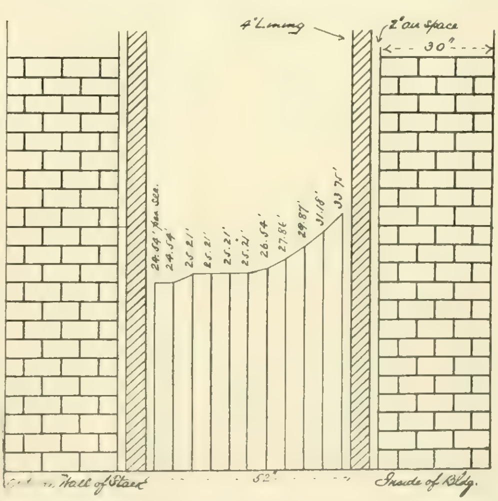


FIG 2.—RESULT OF TEST OF AIR VELOCITIES IN CHIMNEY.

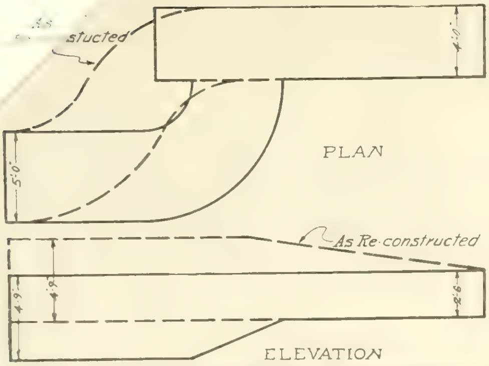


FIG. 3—CHANGES MADE IN SMOKE BREECHING TO REMEDY POOR CONDITIONS.

neys that are in the wrong place. If the chimney is such that it strikes the center line of the boiler, it should be connected to one end or the other of the boiler by curved breeching. The correct way of setting this, however, would be to either have the chimney at the front or rear of the boiler, lessening the length of breeching run. The elevation shows the kind of connection that should be at the rear or front, and in no case should it be connected with the center line of the boiler. The damper shown in the front connection on the elevation plan is wrong, because when it is wide open the opening is half closed. It should be placed at the side of the boiler shown in the plan section. If at the rear, it should be made as shown in the rear. It doesn't cost any more; is always available for doing its duty, and doesn't interfere with other boilers connected on the same run of breeching. If the breeching is carried across the top, the damper should be made as shown in the small cross section to the right of the figure. This will not interfere with the gases from any other boiler, and when open, dampers built after this manner will allow the pull of the stack to begin at the boiler, instead of meeting resistance offered by a wrong construction which reduces the size of the original opening, and prevents the stack from delivering the air to the furnace that it would or should deliver.

Fig. 5 shows the damper opening usually found in horizontal tubular boilers, and though it may have the proper area, it forms a contraction and resistance to the gases due to its shape, which should be as shown in Fig. 6.

Fig. 6 shows the opening of the damper extending the entire distance across the boiler, and allowing the free passage of the gases over more heating surface than is allowed in Fig. 5, while less resistance is offered to the flow of the gases at this point. In all settings where the free flow of gases is required, there is nothing gained by having the construction so that pockets are formed within the setting, preventing the free circulation of the gases around the heating surface. If the draft is too strong,

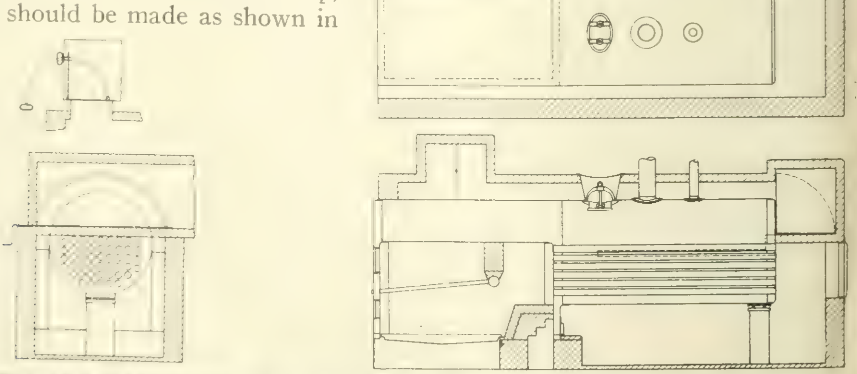
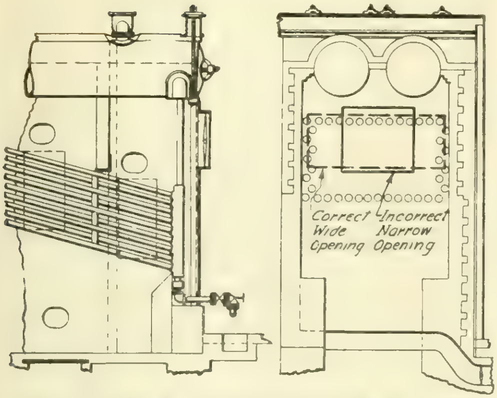


FIG. 4—RIGHT AND WRONG WAY OF CONNECTING BRICK-SET BOILERS TO CHIMNEYS IN WRONG PLACE.



FIGS. 5 AND 6—CHANGES MADE IN DAMPER OPENING IN SMOKE BREECHING TO SECURE BETTER OPERATION.

the damper can be partially closed to obtain the desired results, so that the volume of gas that the chimney will produce or the draft that it will produce is available at the damper.

Fig. 7 is a reproduction of an actual occurrence; the heavy lines showing the ordinary construction and the dotted lines showing the change on this type of boiler. It represents the difference between success and failure on this particular setting and it follows in every like construction and practical operation, where breechings are built after this manner extraordinary draft losses occur.

In Fig. 8 the design in the upper right-hand corner represents the usual construction of a breeching for low-pressure work; this construction very materially reduces the draft over the construction shown in the lower left-hand corner by eliminating three right-angle turns of the gases.

The breeching shown in the lower left-hand corner is less expensive to build and is better from every point of view, representing the same setting, chimney being in the same place in both instances.

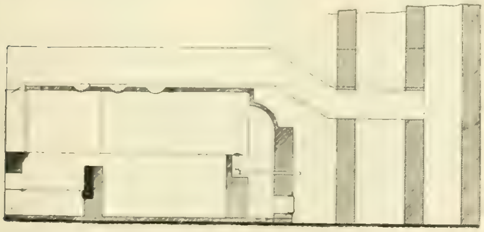


FIG. 7—ANOTHER INSTANCE OF REMEDYING CONDITIONS BY CHANGING SMOKE BREECHING.

Fig. 9 is a chart of the actual steam consumption of 2,500 sq. ft. of radiation under mild, medium and severe weather conditions, to produce the heat necessary to heat the building. The capacity of the boiler was about 660 lbs. of steam per hour. It will be noted that it had very little to do under the mild and medium weather conditions—that is to say, that the load was quite regular, and the outside temperatures were above freezing and at freezing, while the inside temperatures were maintained at 70° F. The top curve represents a severe weather condition—around 15° below zero, and shows the steam necessary to be produced to heat 2,500 sq. ft. of radiation. In this given instance, it maintained a temperature in this building of 70°. The curve showing the radiation of the boiler indicates what in average practice would be the size of the boiler for the amount of radiation.

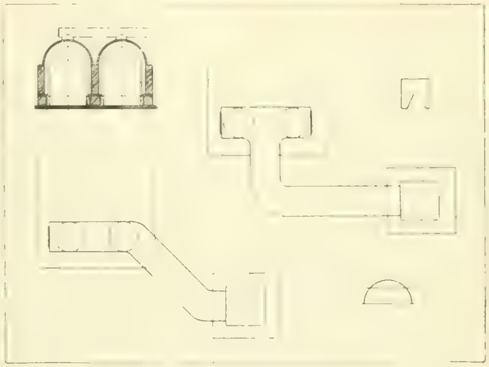


FIG. 8—TYPICAL DESIGNS OF SMOKE BREECHINGS.

These curves are not theoretical, but were obtained by weighing the condensation from 2,500 sq. ft. of radiation in actual use, and are used here to impress upon the mind of everyone who is dealing with this phase of engineering, the necessity of providing a draft or a chimney for the maximum load that the boiler will be called upon to produce. Every heating boiler is subject to this load fluctuation. When it is realized that the draft required to cause the flow of gas increases as the square of the velocity, it will be seen that this is very important. For instance, if a half-inch of draft in the uptake is sufficient for satisfactory operation at one capacity, doubling the capacity at least doubles the quantity of gas, which means that the gas must flow twice as fast. Assuming that the furnace's efficiencies and temperatures were the same in both cases, theoretically, therefore, it would take four times as much draft, or 2 in. as measured by the water column, and it is for this very reason that many buildings in severe weather conditions are not heated properly.

In other words, it is the usual practice on a one-story building to build a one-story chimney, and on a two-story building to build a two-story chimney. If a three-story building, it is a three-story chimney, and so on up to the twenty-one story buildings, all of which are heating with the same relative capacity boilers, and the same efficiencies are expected in all cases (it is assumed that in all cases there is sufficient radiation to warm the building to the proper temperature under all outside conditions).

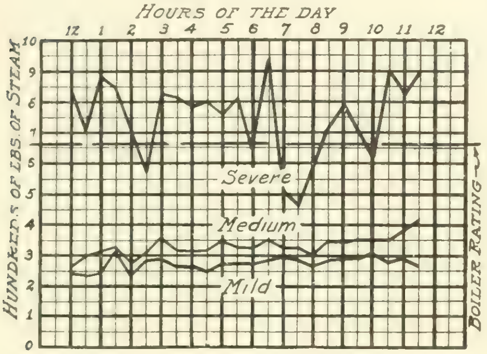


FIG. 9—RECORD OF STEAM CONSUMPTION UNDER MILD, MEDIUM AND SEVERE CONDITIONS.

No heating boiler should be connected to any chimney whose volume is sufficient, that does not produce at least 2/10-in. of draft at the damper. If there is a run of breeching from the boiler to the chimney, chimneys must be higher than where this connection is up close to the boilers. It is an extremely lame excuse to fall back on the old statement that our apartment buildings with the proper height of chimney for the proper combustion of the fuel, would look like factories. Of course, in dwellings where the prevailing apparatus is hot air or stoves, this rule should not necessarily be followed. The areas of chimneys for heating work should be in the proportion of four and one-half to one of the grate surface.

Smokeless Combustion as Applied to Single Grate Boilers

By JAMES F. McINTIRE.

Engineer for the United States Radiator Corporation.

The most noticeable effect of incomplete combustion in a boiler is the production of smoke. Smoke, however, is usually less serious from the standpoint of efficiency than the invisible effects of which the smoke is an indication. Therefore, aside from a desire to meet the smoke abatement law requirements, a boiler should be designed to prevent the loss of the invisible wasteful gases C O, free hydrogen and unburned hydrocarbons.

Chemistry of combustion proves that this loss can be eliminated if just enough air is supplied and if all the combustible in the coal is consumed, the resultant flue gas containing 21% C O.

This complete combustion is impossible in actual practice, due chiefly to the fact that the oxygen of the air can not be mixed thoroughly enough with all the combustible in the fuel.

Excess air supplied to the fuel assists in bringing oxygen in contact with the combustible but all excess air is wasteful as it passes through the boiler to the chimney chemically unchanged, yet raised in temperature 400° F. or more.

The amount of excess air required for complete combustion can be greatly reduced by providing a means of mixing the air and combustion gases.

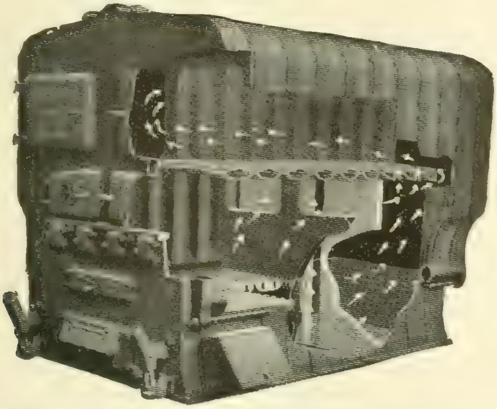


FIG. 1—TYPICAL CONSTRUCTION OF SINGLE-GRATE SMOKELESS BOILER USING COKING METHOD OF COMBUSTION.

The more complete the combustion the more smokeless the boiler operates. When combustible gases are chilled below the ignition temperature, due either to low fire-box temperatures or contact with heating surface, combustion is arrested, with smoke and poor economy as the result.

As an illustration of the points just mentioned Fig. 1 is presented to show the construction of a smokeless boiler which contains a large fire-box or furnace where bituminous coal is burned at a rapid rate of combustion. The air is admitted principally through the grates and fuel bed, with an auxiliary supply admitted at the front of the furnace, which mixes with the volatile gases distilled from the fuel bed.

These volatile gases pass from the furnace into a mixing chamber through two horizontal openings at the top and in the back of the bridge-wall of the furnace (Fig. 2). This mixing chamber back of the furnace is formed by the bridge-wall at the front and an ignition wall of fire-brick at the rear of the mixing chamber (Fig. 3). The fire-brick used in the mixing wall has a fusing temperature of 2700° F.

The temperature of the burning gases coming in contact with this ignition wall does not reach this point by several hundred degrees so that the fire-brick used in the ignition wall is practically indestructible. Because of the continuous volume of burning gases pouring from the furnace through the bridge wall and against this ignition wall it is constantly maintained at a temperature of approximately 1600° or about 400° above the ignition point, the temperature at which these gases burn.

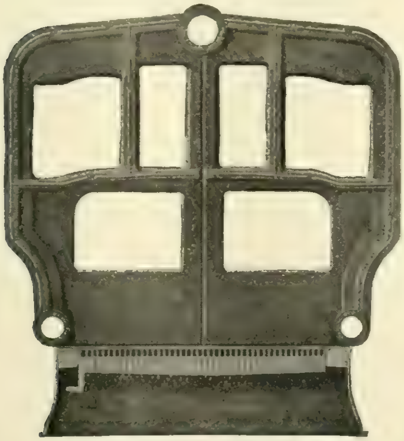


FIG. 2—BRIDGE WALL SECTION.

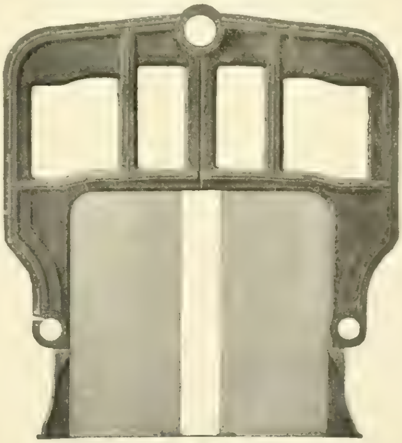


FIG. 3—IGNITION WALL SECTION.

Ignition wall is used here in the sense that the fire-brick assists in igniting the combustible gases, rather than the common use of igniting green fuel.

All the gases from the furnace must pass through this mixing chamber, and while they enter the mixing chamber through two horizontal openings, Fig. 2, their escape from the mixing chamber to the combustion chamber at the rear of the boiler is through a long vertical opening in the ignition wall, Fig. 3, the area of which is slightly less than the area of the two horizontal openings into the mixing chamber. The effect of this arrangement is a congestion and intermixture of burning gases within the mixing chamber in contact constantly with the ignition wall, which is maintained at a temperature above the ignition point of the gases.

The combustion of these gases is completed in the combustion chamber at the rear of the boiler where the temperature is but slightly lower than that of the mixing chamber and well above the burning point of these gases. From the combustion chamber the gases are rapidly cooled in the large flues, passing to the front of the boiler on each side, Fig. 1, from which point they are returned to the smoke-hood through the inner flues of equal area.

The use of this mixing chamber, with its ignition wall, and the combustion chamber, is intended to completely burn the volatile matter in the fuel before the gases are cooled below their burning point, and thus fulfill the requirements for smokeless combustion.

As the volatile matter of the coal is completely burned in the boiler there is no smoke to escape to the open air except during the time when the fire doors are open and the coal is being fed to the boiler.

The Sales Engineer

By F. R. STILL.

(From a paper read at a recent meeting of the Michigan Chapter, A. S. H. & V. E.)

Most large institutions now employ an operating staff of engineers bearing, at least, the following titles, and some concerns have many others in addition, viz.: consulting engineer, construction engineer, engineers of tools and equipment, electrical, power plant, chemical, metallurgical, production, planning, scheduling, efficiency, costs, estimating, transportation, service, inspection, employment, welfare and sales.

There is hardly any other branch of engineering where such a direct measure of a man's efficiency can be obtained by the manager as in sales engineering. The sales engineer comes before him every day in one form or another. Maybe it is through orders, reports of sales, expense accounts, collections, some clause in a contract, service, engineering; but, be it what it may, it keeps him constantly before the manager and the principal heads of departments and he is being mentally measured day by day by every one of them.

Exceptionally good men are scarce; none of them are ever overlooked; mediocre men always think they are, and some of them are overlooked. I may even go so far as to say that some of them are purposely overlooked.

The qualifications of a first class sales engineer may be properly divided into five heads, entitled educational, practical, business, social and moral.

EDUCATIONAL TRAINING.

Practically every concern now employs graduates from engineering colleges or schools to the exclusion of all others, for any branch of engineering work. A few break into the sales work who have come up from the ranks, but not many.

In addition to a thorough grounding in general engineering, a student who contemplates sales work must study commercial law, insofar as it concerns building construction, land titles, liens, bankruptcy, receivership, corporation acts, contracts, bonds and commercial paper.

He must have a good command of language, know how to give expression to his thoughts, be able to write good, clear, definite and convincing letters.

His engineering knowledge must be so broad that he can discuss with and advise any customer, whether such be an architect, or engineer of high standing, on matters entirely outside his own particular specialty, because the impression gained by the customer from the knowledge he exhibits of those things which his customer knows all about, immediately establishes the confidence the customer feels he can place upon the advice given him in those things about which he knows little or nothing.

PRACTICAL TRAINING.

This, of course, covers experiences, more or less prolonged, in every branch of his line of both engineering and business. It includes machine design, planning and all the other branches of drafting-room work; experience in all the various departments of the office and shop; outside construction work; estimating; correcting difficulties with customers; making installations work right, etc. Here he gets his hard knocks and learns more of real value than he realizes until later on. It is here where many of the students break down. They do not understand why they should put in months at this sort of thing after spending four years at college. Those who stick it out are always glad they did, long after it is over.

BUSINESS TRAINING.

Business training can only be gained by actually doing business with people. Certain things can be learned from books and lectures but the everyday meeting and dealing with people is the final course.

One can learn by study how to draw up specifications, contracts, keep a set of books, draw up all kinds of legal forms, learn how to determine the amount of credit to extend to an individual, what kind of terms to allow, how to figure costs, overhead and profit on various kinds of work, but it takes business sagacity coupled with real business experience to avoid the many traps and pitfalls laid for a salesman.

SOCIAL TRAINING.

Most corporations look quite carefully into the home life and surroundings of every young man for this class of work. It is necessary, as he is to be the personal representative of the company and he must be fit to associate with anybody. He must naturally be a "good mixer" and know how to wear a "Billy Baxter front."

He must cultivate a taste for clean sport and be able to take a hand at most of the outdoor and indoor games which form the pastimes of business men.

He must be pleasant and agreeable without making his presence offensively noticeable in trying to attain such a demeanor. It must be natural.

The value of various clubs, societies and fraternal organizations in business affairs is questionable; to the average man it is repulsive when anybody tries to work such a connection as a leverage to get attention or special consideration. Most men will go out of their way to turn down such a fellow.

Belonging to some such organizations is helpful in broadening acquaintanceship and frequently does lead to greater familiarity than might be possible in any other manner; membership in such societies sometimes makes it convenient to approach a man on business matters, whereas it might be extremely difficult to get at him in any other way.

MORAL TRAINING.

Family history, home training and temperament count more in the "moral character" of every young man than anything else, assuming he has been brought up in the proper home surroundings. A man cannot be a real gentleman, unless instinctively so inclined.

Clean habits, truthfulness, the temperate use of intoxicants, no gambling instincts and respect for the rights of others, are the cardinal points for consideration in measuring up the moral character of any young man.

FINALLY.

As time goes one, the competition for the higher positions becomes fiercer; not only is it harder for the young man to get started in desirable places, but it is also becoming harder for the old heads to hold on to their positions. The changes which take place in some institutions are swift and surprising. It is a race for supremacy by merit and is only won by the best equipped.

In sales engineering work a man has no chance for demotion; it is a case with him of going higher or getting out. If his salary and expenses exceed a certain percentage of his sales, he is a doomed man in most instances.

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IN PREPARING the matter appearing in this issue on the smokeless combustion of coal it was impossible not to realize the fact that a strange combination of circumstances has raised the smokeless boiler to a place of pre-eminence in the development of the art of heating, at the same time making a discussion of this subject one of the most timely that could be brought before our readers. While for the past twenty years various cities in the United States located in what are known as the soft coal regions have been battling with the smoke nuisance, the campaign attracted but little attention in other localities that were not put to the necessity of using soft coal.

This was the situation when the European War brought home the fact that the price of coal was not a stable proposition after all and that a situation might easily arise that would make it necessary to substitute cheaper grades of coal for the expensive grades that such sections as the East had always been accustomed to. In recent months this situation has developed rapidly. Not only has the price of coal soared to unheard-of heights, but, as central heating plant managers so well know, coal became difficult to obtain at any price. At this critical juncture came the regulation by the government of both wholesale and retail coal prices. While the government's action served to clarify the situation, in a way, it left no doubt in the mind of anyone that high coal prices have come to stay. That is to say, we are at the threshold of a new coal era both for heating and power plants in which the smaller sizes of anthracite and soft coal are to have the call.

With this situation clearly understood it is a matter of the utmost interest to the heating engineer to know that American ingenuity has developed numerous types of apparatus in which bituminous coal can be successfully used, practically without smoke, and with an adaptability ranging from small residence work to that of apartment houses and other large buildings. That the manufacturers have been quick to realize this is evidenced by the unusual number of announcements of their product appearing this month in our advertising columns. Incidentally it is a matter of gratification to state that this is the second largest number of THE HEATING AND VENTILATING MAGAZINE we have ever issued, and the largest in point of advertising patronage. It is also proper to state that the editorial management of our second annual Smokeless Boiler Number has been in the hands of Martin A. Rooney, formerly smoke inspector of Nashville, Tenn., whose wide experience and knowledge of smoke abatement work is reflected in the character and scope of this month's contents.

Novel Method for Obtaining Height of Chimney

A novel method for obtaining the height of a chimney was described in a recent number of the Ideal Heating Journal, the periodical of the American Radiator Company. Two indirect methods were shown which are reproduced herewith. Following are the directions: Take an extension rule so arranged that two sections of the rule are at right angles to two other sections of equal length, as shown in the sketch, Figure A. Place the eye at the end of the long arm and move away from the chimney until the top and bottom of the chimney are in line with the top and bottom points of the short arms of the extension rule. Care should be exercised in having the eye close to the end of the rule. When the points suggested above are in alignment, measure the distance from your position to the base of the chimney. This distance will give the height of this stack. It is, of course, necessary to measure this distance on level ground. To the distance thus obtained, add the distance from the ground to the basement floor. In place of the extension rule there may be used two sticks of equal length, approximately 2 ft. long, with one stick fastened in the middle at right angles to the end of the other. The second suggestion, Figure B, is to obtain a pan and fill with water, placing the pan on the ground at a distance from the chimney. Then move back until the reflection of the top of the chimney appears in the water. Measure the distance you are standing from the pan, also the distance from the pan to the base of the chimney, and the distance from the ground to the observer's eye. The height of the chimney may then be determined as follows: Multiply the distance in feet from the pan to the chimney by the distance in feet from the ground to the eye of the observer and divide this product by the distance in feet from the observer to the pan. The result will give the required height from ground to top of chimney. To this distance should be added, as in the first case, the distance from the ground to the basement floor. A looking glass may be used in place of the pan of water.

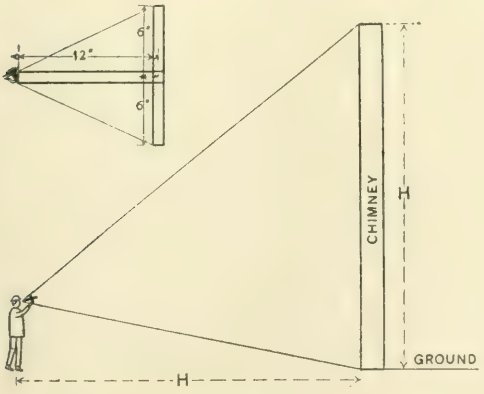


FIG. A.

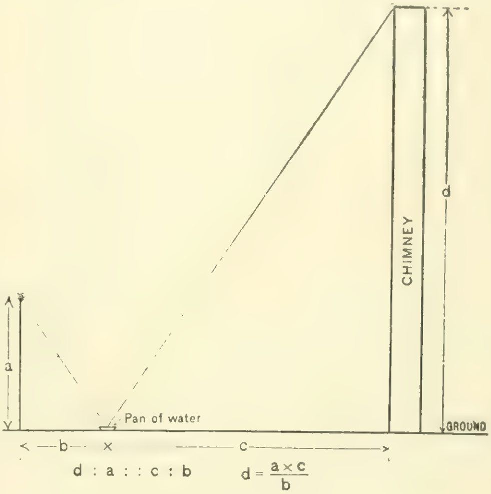


FIG. B.

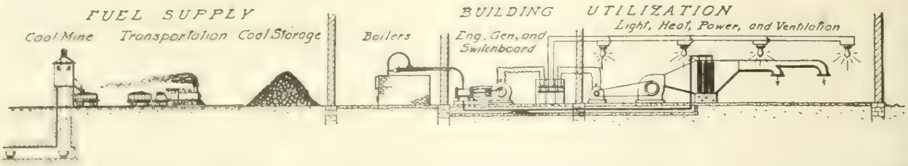
Twelfth Annual Convention of Smoke Prevention Association.

Among the papers read at the twelfth annual convention of the Smoke Prevention Association, held in Columbus, O., September 25-27, was one by Henry Misostow on "Proportioning a Chimney on a Fuel Basis," and one by W. C. Ross on "The Manufacture of By-Product Coke and Its Effect on the Domestic Smoke Problem." A report was presented of the government tests held at the Bureau of Mines in Pittsburgh and there was also a topical discussion of the subject of powdered coal. One day's session was given over to smoke abatement in relation to locomotives.

L. H. Reed, of Chicago, was re-elected president of the association; Daniel Maloney, of New York, was elected first vice-president; J. T. Corbett, Michigan City, Mich., second vice-president; and Frank A. Chambers, Chicago, secretary and treasurer.

Newark, N. J., was chosen as the next convention city.

POWER PLANT ENGINEERING



Notes on Boiler Feeding

When a boiler or battery of boilers is operated at a steam pressure higher than that carried in the heating system it is impossible to return the condensation by gravity; with an open feed-water heater it is also impossible to have any pressure on the feed water over 5 lbs. gauge because the heater—in utilizing the exhaust steam from the engines—must, at the same time, keep the back pressure down to as low a point as possible. Therefore, some means of forcing water into the boiler against the boiler pressure must be supplied.

For this reason in every power plant boiler-feed devices are installed for the purpose of replacing the water in the boilers as fast as it is evaporated into steam. Usually these devices provide for the supplying of *hot* feed-water, as the economy of heating feed-water is now fully recognized and the advantage of saving temperature strains on the boiler, by having the feed-water as near the boiler temperature as possible, is self-evident.

THREE GENERAL TYPES OF BOILER-FEED PUMPS.

The most common method of boiler feeding is by means of boiler-feed pumps of which there are an infinite number of varieties. All feed-pumps, however, may be classified into three general types according to their method of operation, *viz.:*

(*a*) Piston and plunger pumps.
(*b*) Rotary and screw pumps.
(*c*) Centrifugal pumps.
(*d*) Jet pumps.

Piston and plunger pumps—which are by far the most common type of boiler feed pump used for building power-plants—consist of two cylinders in one of which steam operates a piston, connected by a piston rod, to the piston or plunger in the water cylinder, thus moving the water and resulting in pumping when properly arranged and valved.

These pumps, when consisting of one water cylinder, are termed *"simple"* pumps and give a pulsating discharge which is overcome to some extent by mounting two pumps together and operating the steam ends, so that one pump is in the middle of its stroke when the other is at the end. Such pumps are termed *"duplex"* pumps and are much perferable to the simple pump. Practically all boiler-feed pumps are built double-acting—that is, the piston or plunger moving toward one end of the cylinder is not only forcing the water along ahead of it but is also drawing water into the cylinder behind, ready to be pumped out on the reverse stroke.

A piston pump is not regarded by some as highly as a plunger pump, the water between the piston and cylinder being much harder to take care of than if a plunger and bushing are used; "outside packed" pumps are more easily repaired than those with inside packing.

To illustrate clearly the difference between the piston and plunger type of pumps Figs. 1 and 2 are shown. In Fig. 1 the piston arrangement is given, the piston operating within a cylinder in the same manner as the steam piston in the steam cylinder at the opposite end of the pump. The piston moving back and forth inside the cylinder, draws the water from the suction chamber up through the lower set of valves into the pump chamber; on the reverse movement the water is driven out of the pump chamber and up into the discharge chamber through the upper set of valves. Wear in the cylinder can only be taken care of by means of reboring.

In Fig. 2 the plunger arrangement is indicated, the plunger moving back and forth inside of the bushing shown; the cycle of operation is similar to the piston pump but the location of valves and chambers is slightly changed. The steam consumption of these pumps runs from 60 to 120 lbs. per H. P. but, as the exhaust is used in the heating system and as the pump H. P.

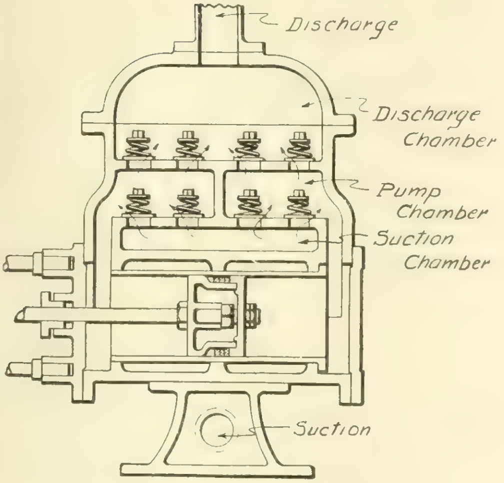


FIG. 1—PISTON TYPE OF PUMP.

is a relatively small amount, this is not a serious matter.

HOW TO FIGURE DISCHARGE FROM "SIMPLE" PUMP.

On piston and plunger pumps the piston speed should never exceed 100 ft. per minute or 60 double strokes so that the discharge from any "simple" pump is obtained by the following formula:

100 A × 7.5 + S = gallons per minute delivered.

When A = Area of water cylinder in square feet
100 = Piston speed in feet per minute
7.5 = Gallons per cubic foot
S = Slippage—usually 10% to 15% in ordinary pumps

Thus, for 12,000 gallons per hour

$$100\text{ A} \times 7.5 = \frac{12000}{60} + 10\%\text{ of }\frac{12000}{60}$$

$$\text{A} = \frac{200 + 20}{100 \times 7.5}$$

$$\text{A} = \frac{220}{750}$$

$$\text{A} = 0.293\text{ sq. ft.}$$

Diameter = 0.61 ft. or 8 in. diameter.

For a "duplex" pump the area of each cylinder would be just one-half or

$$\frac{0.293}{2} = 0.146\text{ sq. ft.}$$

Diameter = 0.43 ft. or 5⅛ in. Probably a 5-in. cylinder would be used.

Air chambers are recommended on all piston pumps to absorb the shock of discharge and provision would be made for renewing the air supply as fast as it is carried away by the water. One large power producing corporation has all their air cylinders tapped and gauge glasses installed so that the quantity of air is visible to the engineer at all times. The volume of the air chamber on single pumps should be equal to three or four times the volume of the water cylinder, but on "duplex", one-half to one-third the volume of the water cylinder is sufficient.

To check the size of the steam cylinder, the operating steam pressure must be known and the total head against which the pump is operating, including both suction and discharge. It is not usually customary to have a boiler-feed pump, which is handling hot feed-water, do any lifting on the suction side so that the discharge pressure only need be considered. With 100 lbs. of boiler pressure the pump must discharge against the boiler pressure plus the pipe friction between the pump and the boilers.

If 10 lbs. friction in the pipe line is allowed the total pressure against which the pump operates will be 100 lbs. + 10 lbs. = 110 lbs. per square inch. But the pump also has internal friction within itself for which it is customary to allow about 25%. Then if the water cylinder is 8 in. in diameter the total load on the piston will be

50.26 × 110 × 125% or
50.26 × 137.5, or 6911 lbs.

To counterbalance this on the steam end

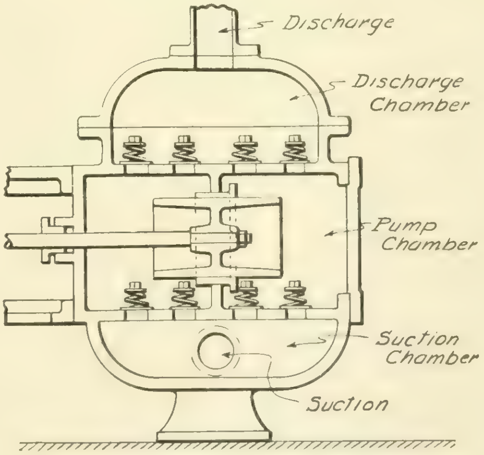


FIG. 2—PLUNGER TYPE OF PUMP.

the area of the steam cylinder must be not less than

6911 ÷ 100 = 69.1 sq. in or 9½ in.

With a duplex pump it would be 19.63 × 110 × 125%, or 2699 lbs.

2699 ÷ 100 = 27 sq. in., or 6-in. cylinder.

The length of stroke is obtained as follows:

Piston Speed = 100 f.p.m.

Maximum number of double strokes = 60.

Total number of single strokes = 60 × 2, or 120.

100 ft. movement ÷ 120 single strokes = 0.83 ft. per stroke, or 5/6×12=10 in. stroke.

Therefore the size pump required would be a
9½ in. × 8 in. × 10 in. single, or a
6 in. × 5 in. × 10 in. duplex.

The reader, of course, is aware that in designating a steam pump the first figure is the diameter of the steam cylinder, the second figure the diameter of the water cylinder and the last figure the stroke-all in inches.

As a basis for figuring the gallons per minute required, the maximum number of pounds of steam made per hour is divided by 8⅓. Where the boiler horsepower is used as a basis the nominal rating must not be used but instead the actual boiler horsepower produced. Thus, for 200 H.P. boilers run at 25% overload the actual B.H.P. produced is 200 × 1.25 = 250 H.P.

250 × 30 lbs. of water = 7500 lbs. of water per hour.

7500 ÷ 8⅓ = 900 gal. of water per hour. which should be increased slightly for safety, calling it, say, 1000 g.p.h.

Good practice demands the installation on small plants of two pumps each of 100% capacity, either of which can feed all the boilers when carrying their maximum load. On larger plants three pumps are sometimes used each of 50% capacity so that any two can supply the boilers, with the third as a spare pump.

In cases of economy a pump used for another purpose is sometimes depended upon as a spare pump in case of emergency. For instance, a hot water circulating pump made of the same type and capacity as the boiler-feed pumps might—by proper cross-connecting—be made to save the installation of another spare pump.

A three-cylinder pump is termed a *"triplex"* pump, but is so seldom used for boiler feed that it may be ignored in this discussion.

ROTARY AND SCREW PUMPS.

The second classification of pumps, *viz.:* rotary and screw pumps—is but little used for power plants. These pumps operate by the interlocking of lobes or screw threads between two parallel shafts, combined with the movement of the lobes or screw threads against the casing. The travelling of the lobes or the threads along the casing transports water from the suction to the discharge side while its return is prevented by the interlocking of the lobes or threads in the middle. A rotary pump is illustrated in Fig. 3 and it is self-evident that it would be impossible to accommodate wear in such an arrangement, this indeed being the greatest objection to this type. Their use is more common for fire service where short service and positive action are the main features of their operation.

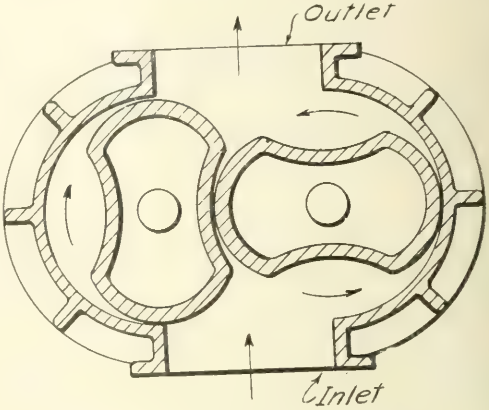


FIG. 3—TYPICAL ROTARY PUMP.

CENTRIFUGAL PUMPS.

The third classification of pumps includes all centrifugal pumps in which the water builds up a pressure against the outside casing from its centrifugal force caused by being rapidly rotated by an interior propeller. The action is largely similar to that attained in the centrifugal fan familiar to all our readers. To balance the pressure the suction water is often admitted to the center of the casing from both sides and discharge taken from the side of the casing, as shown in Fig. 4. These pumps are not particularly efficient, the efficiency hovering around 50% to 60% and falling off rapidly at high pressures; when used for boiler-feed purposes they are compounded into two-stage or three-stage pumps, each stage being virtually a complete centrifugal pump in which the water enters the suction at the pressure discharged from the previous stage and is boosted up in pressure by the addition of the centrifugal pressure created by the stage in question. Each stage is usually considered as raising 40 to 50 lbs. pressure; thus a pump operating against 35 lbs. would be a single-stage, against 80 lbs., a two-stage and against 125 lbs. a three-stage pump. All centrifugal pumps must be belt, motor or steam turbine driven, owing to their high speeds.

The amount of slip which may be expected in centrifugal pumps expressed in percentage of the theoretical volume pumped is as follows:

Small size: at low speed 60% at high speed 75%.

Medium size: at low speed 40% at high speed 50%.

Large size: at low speed 15% at high speed 25%.

JET PUMPS.

The jet pump, when used for boiler-feed work consists of a device that is commonly termed an "injector" and its principle of operation seems to introduce a real mechanical paradox. How a jet of steam which must be fed from a source of steam supply at a pressure somewhat lower than the boiler (due to the pipe friction) can attain a velocity sufficient to again re-enter the boiler against the higher pressure seems peculiar; that it can not only insert itself but at the same time can carry sufficient water with it to serve as a feed for the boiler is very remarkable, and the fact that it can lift this water a considerable distance by suction in order to accomplish its work seems impossible.

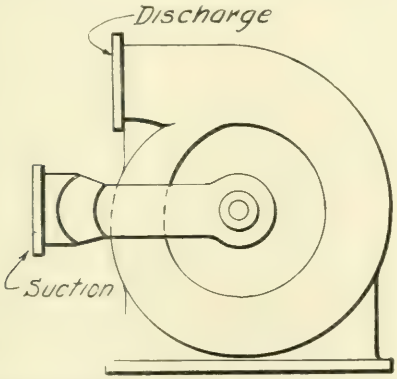


FIG. 4—TYPICAL FORM OF CENTRIFUGAL PUMP.

The most simple form of injector is illustrated in Fig. 5 where opening the steam valve in the steam line will cause steam to flow at a high velocity through the interior nozzle and into the pipe leading to the boiler. In order to start the lifting of water through the suction line a cold water line is connected in at the top so as to allow the condensing of the steam jet after it has started, thus producing a vacuum and drawing up the water in the suction pipe, after which the water valve is closed. If the suction pipe is furnished with water under sufficient head to cause it to flow into the boiler pipe without requiring suction the water pipe may be omitted.

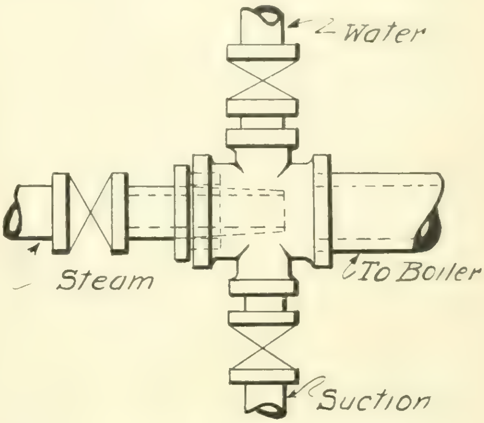


FIG. 5—SIMPLE FORM OF INJECTOR.

The thermal efficiency of an injector is almost 100% as practically all the heat in the steam is again returned to the boiler, but it will not handle hot feed-water and therein lies its objection. The injector principle has been developed along various lines by manufacturers and there are many good and reliable makes on the market; the use of the injector in the building power plant is limited to emergency cases only. In some instances they are installed in place of a spare boiler-feed pump, resulting in quite a saving on the initial expense for pumps.

Notes

It is claimed that 63% of New York's 154 largest buildings, representing 78% of the total valuation, have independent power plants. The buildings listed in classes show that of the

Railroad Stations	100% have power plants
Hotels	96%
Offices and Stores	72%
Banks	57%
Clubs	57%
Apartments	37%
Theatres	0%

In Philadelphia for a given section, out of 192 buildings, 137 have power plants.

In these days of the high cost of brass strict watch should be maintained of articles furnished under specifications calling for brass. Some unscrupulous manufacturers are turning out iron or steel parts and having them brass plated, giving them every outward appearance of the genuine article. A small magnet carried in the pocket will enable one to detect such substitution, as the magnet will cling to any object containing iron or steel.

CORRESPONDENCE

Removing Oil from Radiators.

Editor Heating and Ventilating Magazine:

I have a large amount of radiation on a forced hot water system which has grown quite inefficient due to oil getting into the system from the fuel oil lines. Please inform me the best way to clean the oil from the inside of cast-iron radiation. Turning high-pressure steam and boiling water into the radiation will likely wash it out, but will it remove the oil film? Could you suggest any acid or lye bath or any practical method of cutting the oil out? Also, can you offer any suggestions as to making a permanent washing apparatus for radiators?

L. L. B.

Bremerton, Wash.

Oil is not a new factor to be encountered in steam heating systems and its existence therein results in numerous troubles such as a fluctuating water-line in the boilers, water in the steam lines, water hammer, and loss of efficiency in the radiating surface. Oil is hardly ever encountered, however, in any but new systems and in this respect our correspondent's complaint is very unusual; how fuel oil could enter a hot water heating system against the static head of the water contained therein, is not very easy to conceive but assuming that the oil has entered the system the thing is to get rid of it as thoroughly as possible and in the quickest practical manner.

For this we would recommend the well-known soda treatment which (on a steam system) consists of adding about 5 lbs. of common washing soda to the boiler water and boiling slowly for an hour, then blowing off the entire charge and refilling with cold water; this second charge is filled up higher than the proper water line so as to thoroughly wash out the interior of the boiler and, after boiling for a short interval, is also blown off. Then the boiler is refilled a second time and is ready for use. This process is repeated whenever the oil coming back from the piping system collects in sufficient quantity to become troublesome.

In the case under consideration, owing to its being a hot-water system with "a large amount of radiation," it is probable that 15 or 20 lbs. of soda would have to be used in order to produce a solution of the required strength with such a large volume of water. This soda dissolved in water and injected into the system can be circulated through the pipes and radiators by the circulation pump, then the system emptied, refilled and washed out, and then refilled a second time the same as for a steam boiler.

Owing to its being impossible to "boil out" the system with the soda solution the results may not be wholly satisfactory and, if an examination after the soda treatment shows the oil still present, lye or potash should be used as a final remedy. It is not necessary to use as much lye as soda, probably about 5 lbs. will be sufficient to remove the oil; the action of the lye when coming into contact with grease or oil is to cut the grease so as to make it dissolvable in water, a familiar example of this being found in common soap; the grease after dissolving in the water and forming a soapy solution is carried out of the system when the water is changed.

We do not know of any way of "making a permanent washing apparatus for radiators," if by this is meant a method of continuously cleaning them of oil. In a hot-water system the oil would be likely to seek the highest parts of the system, collecting there due to its lighter specific gravity, and a blowoff or overflow from such points might remove the major part of the trouble; it would not, however, prevent the oil forming a film on the interior of the piping and radiators which is the greatest source of trouble here.

We do not believe that high pressure steam or hot boiling water would be of any use in removing the oil but, on the contrary, might burst the radiators due to the excessive pressure.

Are Two Smaller Boilers as Efficient as One Large Boiler, the Capacities Being Equal?

Editor Heating and Ventilating Magazine:

I would appreciate your opinion on the following much discussed question:

Which is the more efficient, one larger cast-iron sectional boiler for a low-pressure heating job, or two smaller boilers having a combined rating equal to the one large boiler?

To be specific, I have a building containing 7,000 sq. ft. of direct radiation. The boiler I have in mind to use is one with a rating of 12,000 sq. ft. and a grate surface of about 26 sq. ft. This can be installed at a saving of about $800.00 over a two-boiler plant, the two boilers each have a rating of 6,000 sq. ft. and a grate area of about 23 sq. ft. each.

Would the saving made in increased efficiency (if any) of the two-boiler plant over the one boiler, make up in a reasonable time the added initial cost of the two-boiler plant?

What merit is there in the large boiler manufacturers' claim that their relatively smaller, shorter grate permits a relatively longer flow of hot gases over the heating surface, this sending cooler gases out through the smoke stack, and that a thicker fire may be carried, thus lessening the amount of attention to coaling? J. C. L.

Indianapolis, Ind.

We unhesitatingly recommend the use of two boilers for a heating plant of this size, the advantages of two smaller boilers over a single large boiler consisting of the following:

(*a*) A more dependable heating plant as a breakdown in one unit would allow the entire building to be operated on the other in ordinary weather and the more important portions even in extreme weather.

(*b*) The use of a smaller unit run at a more active rate of combustion during all ordinary weather. This means a smaller radiation loss than if a boiler twice as large were used and the higher rate of combustion will give a greater evaporation per pound of coal burned, due to the increased radiant heat and therefore a greater efficiency.

(*c*) It is easier to run a smaller boiler fire at a fairly active rate of combustion than it is to run a fire twice as large at only one-half the rate of combustion.

(*d*) It is usually possible to hold a much more even steam pressure with two boilers by firing alternately so that one fire is coming up at the time the other is going down.

(*e*) The coal charge for two boilers is usually much larger than for one boiler of double the capacity because it is customary in the trade to figure a lower rate of combustion on smaller boilers. This is particularly noticeable on the two propositions under consideration where the single 12,000 sq. ft. boiler has a grate surface of 26 sq. ft. and the two 6,000 sq. ft. boilers have a combined grate area of 46 sq. ft. To develop full boiler rating at an efficiency of 8,000 B.T.U. per pound of coal and 250 B.T.U. per square foot of radation this means

$$\frac{12000 \times 250}{8000 \times 26} = 14.4 \text{ lbs. per square foot of}$$

grate for the larger boiler.

$$\frac{6000 \times 250}{8000 \times 23} = 8.2 \text{ lbs. per square foot of}$$

grate for the smaller boilers.

We believe that the larger boiler is overrated as the combustion rate of 14 or 15 lbs. of coal per square foot of grate is entirely too high for ordinary natural draft conditions and it could never be reached in actual practice except under very unusual circumstances. With a good chimney 8 lbs. per square foot on the two smaller boilers in extreme weather is perfectly practical or at least much more so than 14 or 15 lbs. under the same conditions.

For the case under discussion we would recommend two boilers each of 60% capacity allowing 25% for radiation on the mains. Thus:

7000 + 25% of 7000 = 7000 + 1750 = 8750 total square feet of radiation.

At 250 B.T.U. per square foot 8750 × 250 = 2,187,500 B.T.U.

At 8000 B.T.U. per pound of coal, 2,187,500/8000 = 273 lbs. per hour.

At 10 lbs. per square foot of grate = 273/10 = 27.3 grate area for two boilers or 27.3 × 60% = 16.4 sq. ft. per boiler.

If the grate area is proportional to the smaller 6,000 sq. ft. boilers this would make the rating on the smaller boilers

$$6000 : \times : 23 : 16.4.$$

$$\frac{6000}{23} \times 16.4 = \times \text{ or } 4275 \text{ sq. ft. rating,}$$

instead of 6,000.

This will cut out some of the $800.00 additional cost of the two 6,000 sq. ft. boilers.

We also believe that the saving would, in a reasonable length of time, reimburse the owner for the added cost of installation, to say nothing of the increased convenience of operation.

In regard to the last part of the inquiry we do not attach a great deal of importance to the factor of grate length and its bearing on boiler efficiency. While the temperature of the gases in the stack might be higher—as would be the case if a boiler were being run as hard as possible—still the added radiant heat more than offsets the small increase in stack losses. Boilers with proper heating surface when tested have shown an evaporation of 8.96 lbs. of water when run at a 9-lb. combustion rate and 9.47 lbs. of water when run at a 24-lb. combustion rate, thus indicating greater efficiencies under forcing and, therefore, under higher stack temperatures.

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Evolution in the Art of Heating, as Seen by an Old-Timer.

Editor Heating and Ventilating Magazine:

Your editorial in the August issue has struck a very responsive chord up at my little hole in the wall. My record of 64 years' service enrolls me automatically as one of the "Old Guard,"—13 years at the trade, 17 years as a contractor and 34 years specializing, principally in very low pressure steam heating and, finally, in vacuum principles. It strikes me that the "Old Guard," like the G. A. R., are fast becoming a dissolving view, and I believe I voice the feelings of the remaining few when I say that our successors do not avail themselves of our experiences to the extent that we are willing they should do.

In all arts alike unless the younger set begins where the older men left off, a regular tread-wheel process results, each man starting back nearly at the beginning, thus rendering both progress and evolution difficult. Perhaps I can not better illustrate this than by taking the inspiration of your reference to vapor heating systems and enlarging upon it to the extent of stating a few interesting facts.

Vapor systems were brought to great perfection (for the times) in France by a man named Debessant, a hundred years ago. In 1883 I visited New York especially to inspect a heating plant in the Metropolitan Opera House, erected upon a contract given to Frank Tudor—*carte blanche*. In the 34 years elapsing I have seen no promotions or suggestions or erections of any vapor heating system that in any way compares with that in the opera house. I question very much if any of the promoters of vapor systems would assume the responsibility of placing a vapor system on a job of that size and importance, even to-day. The Tudor fractional valve, in finish and function, has not been excelled by any later-day device.

Suggested by conditions that were favorable, in 1883 or a year later than the Williams patent date, I erected my first vacuum heating system. It seems interesting that in March, 1897, or just 14 years later, I assumed the responsibilities of the Webster heating department, in a patent-protected business. Under purely physical conditions, the limitations of vacuum heating systems were reached by myself in a prospect for the Kodak Company, in Rochester, where no vacuum could be secured at the remote positions. I designed and patented a special functional device to meet such requirements and later, in an extension of the same plant, I easily carried steam at atmosphere 3,000 ft., a longer distance than could be effected by a regular vacuum system even if 30-in. of vacuum were maintained. The dates of these developments were 1902 and 1906.

In my opinion engineers are actually derelict in not having an experimental bureau, liberally endowed to enable them to test and thresh out the wheat from the stubble, and drive out of the market defective materials and systems. I am intensely interested in the younger and less experienced men in the profession. As my entrance into the art dates from a period when gravity returns were not thought of, and when the returns were discharged to the sewer through a cracked valve, and afterwards at that point a trap was installed, it will indicate I have traveled an uncharted sea, the shoals and perils of which I would gladly prevent my successors from experiencing.

C. A. Ball.

New York.

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Reminiscences of an Engineer.

Editor Heating and Ventilating Magazine:

In connection with the article by the writer which was published in The Heating and Ventilating Magazine for September, on the subject of "Reminiscenes of an Engineer," the illustration entitled "Cross-section of the Merrimac Type of Ram in Civil War Days," should have read "Cross-section of the type of monitors which engaged the Merrimac."

The Merrimac had a pitched roof over her main deck, very much like the pitched roof of an ordinary barn, with dormer windows cut into it, as port-holes for her guns. The roof was armored and protected with old railroad rails arranged alternately, one up and one down so as to interlock. If furnished a protection above her guns on about an angle of 45°, making an iron armor about 4 in. in thickness. Projectiles striking this armor made a short ricochet and slipped over the roof, if they were not heavy enough to crush the roof.

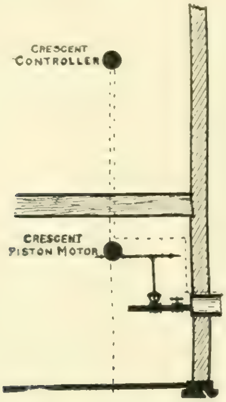
William J. Baldwin.

New York.

Temperature Control.

Editor Heating and Ventilating Magazine:

Referring to the correspondence of L. R. in The Heating and Ventilating Magazine for September and your comments thereon, the writer would say that a system of electric temperature control, such as that described, was exhibited by W. H. Pearce & Co., of Chicago, at the last annual convention of the National District Heating Association, in Detroit. This apparatus is designed to control the temperature either in an entire building or apartment thermostatically and electrically, by opening or closing a valve of any size. It is so arranged that the temperature may be reduced during the night to, say, a drop of 25° F. With this device it is also possible to switch the temperature from day to night from a central station. The device was designed primarily for use in factories and apartments, such as those mentioned by L. R., and has been further developed and made applicable to central station heating, where the throwing of a switch, either manually or automatically, will switch the temperature in a number of buildings from a predetermined day temperature to a predetermined night temperature.



ARRANGEMENT OF CRESCENT TEMPERATURE CONTROLLER.

W. H. P.

Chicago, Ill.

All the vital features of government export control, stripped of their legal verbiage so that the busy man may grasp them quickly, are explained in the pamphlet "The Regulation of Exports Under the Espionage Act," which has just been issued by the Guaranty Trust Company of New York.

LEGAL DECISIONS

Landlord's Duty to Furnish Heat.

The New York Appellate Division, in Perry-Freeman Co. vs. Murphy (March 8, 1917), 14 N. Y. Supp., 74, holds that where a lessor, during the whole of a tenant's occupancy, failed to furnish heat as required and requested, he was guilty of a constructive eviction, which continued and was renewed after each monthly payment of rent.

Unfair Competition Defined.

In injunction proceedings to restrain unfair competition, the Iowa Supreme Court held the evidence sufficient to sustain findings that the defendant's furnace was substantially an imitation or duplication of a furnace manufactured by the plaintiff, that the similarity was intended to and did cause purchasers to buy the defendant's furnace, believing it to be that manufactured by the plaintiff, and that the defendant's advertising and sales methods constituted unfair competition.

What is unfair competition is a mixed question of law and fact, and has been variously defined and applied by the courts. In this case it was held to consist in the conduct of a trade or business in such a manner that there is an expressed or implied representation that the goods or business of the one man are the goods or business of another. It applies in cases where one simulates the particular device or symbol employed by another in such a way as to deceive the ordinarily prudent person, thereby leading him to believe, by the marks thus simulated, that the goods are the goods of another, and thus practicing a fraud upon the person whose goods he simulates, and upon the general public dealing in those goods.

The ground of the action of unfair competition is fraud, and this may be shown by direct testimony, or by facts and circumstances, or inferred from the manner in which the business is carried on.

This doctrine is applied in cases where one has established a business under a particular name, or by the use of certain marks or symbols, so that it has become known in the trade generally as designating the goods of that person. Courts of equity will enjoin one who fraudulently assumes the same name, device, or symbol for the purpose of stealing away from the other the business so established, and thereby depriving him of the profit which flows from the business. There is no practical way, other than by prohibition, to prevent the filching of trade established by one in an article, through a name, symbol, or mark, than by prohibiting the use of the trade name or mark.

Even where the name, symbol, or device used is not one that can be protected as a trade name or mark, equity will protect one in the use of it, where it has, by long use, obtained a secondary meaning, as designating the goods of one particular person, and where, by the use of it, the public has come to know his goods by that name or symbol.

In determining whether a merchant is guilty of unfair competition, it is not alone the similarity in appearance of the goods of the plaintiff to those of the defendant that must be considered, but the methods, representations, and other matters in the conduct of the defendant's business. Lenox Furnace Co. vs. Wrot Iron Heater Co. (Iowa), 160 N. W., 356.

The War and the Heating Engineer

Heating Men in Military Service.

C. W. Chapman, of the Chapman Steam Specialty Co., Canton, O., has been given a captain's commission and is stationed in Washington.

M. G. Harbula, of the New York office of Warren Webster & Co., has enlisted in the Officers' Reserve Corps of the Aviation Section, Signal Corps, U. S. A.

George T. Palmer, chief of investigating staff for the New York State Commission on Ventilation, has been commissioned a first lieutenant in the Sanitary Corps of the army. He is stationed for the present at a point in Massachusetts.

Cantonment Heating.

After several weeks' conferences the plans for heating the cantonments for the new national army were settled. Seven of the cantonments will be heated by steam from central stations and nine will have warm-air furnaces.

Stephan Bros., Council Bluffs, Ia., have the contract for heating the army cantonment at Fort Omaha. A central heating plant is being installed, with two 72 × 16 ft. Kewanee tubular boilers.

Great Lakes Naval Training Station at Waukegan, Ill., for which L. H. Prentice Company, Chicago, has the heating contract, was designed with the idea of giving the greatest amount of salvage possible, inasmuch as the buildings are only temporary and built on leased ground. All radiation is of the wall type, unpainted. The main supply lines are carried overhead, covered with 1-in. air-cell covering; the hot-water supply line and circulating line are also carried overhead on the same supports with the steam line. These pipes are also covered with 1-in. air cell covering and all three lines, steam, water supply and water return, are then wrapped with 4-ply roofing paper. Steam is supplied from numerous small boiler stations in which are installed from one to four standard Kewanee fire-box boilers, with special smoke extension on the rear, similar to traction engines. These boilers are of the standard type, not smokeless and are covered with asbestos cement 1½ in. thick. Each boiler has an individual steel stack. It is the intention to carry about 20 to 30 lbs. pressure on the main line. In each building there is a reducing valve and a single-pipe circuit along the wall of the building, below the radiators, with a single pipe feed to each radiator. The ends of these circuits are dripped through steam traps which discharge through a cooling radiator connected to the sewer. It was not deemed advisable to carry the condensation back to the boilers inasmuch as the installation would not show a saving in the three years of use. Only a few of the radiators are provided with valves. The hot water is also supplied from the central stations and a small electric pump is installed for maintaining the circulation. The water is heated by steam coils in storage tanks, supplemented by Kewanee garbage burners. H. M. Hart, manager of the L. H. Prentice Company, to whom we are indebted for the foregoing description, is in charge of the installation.

H. Kelly & Co., Minneapolis, Minn., is installing the $500,000 heating system at Camp Dodge near Des Moines, Ia., where drafted men from Minnesota and four other northwestern States are being trained. The system will include 18 large central steam plants and several smaller ones.

Camp Grant, at Rockford, Ill., will have a steam heating equipment costing more than $1,000,000. It will consist of 62 return-tube steam boilers of 150 H.P. each, supplying 450,000 sq. ft. of radiation. There will be 17 power stations at the camp.

Camp Custer, at Battle Creek, Mich., will consist of 1,200 buildings more than half of which are now completed. Most of the buildings are steam-heated from 15 large central heating plants. Each one of these heating plants is designed to care for the group of buildings housing a single regiment.

Food Pledge Week.

The week beginning October 28 is to be Food Pledge Week, during which the entire country will be canvassed on the food pledge and asked to sign and support it.

Plans for Second Liberty Loan in New York.

To carry the second Liberty Loan campaign into every trade in Greater New York and to enlist the support both of the customer and the employee, trade committees have been organized by the New York Liberty Loan Committee through its distribution committee. The chairman of the Machinery and Machine Tool Trade Committee is James W. Lane, of the E. W. Bliss Co., Brooklyn, N. Y. Other chairmen are: Steam and Hot Water Trade, J. E. Rutzler; Heat and Cold Insulation Trade, F. F. Cooper.

Work of the Engineering Council.

Among the activities of the Engineering Council, which is an organization composed of members of the four largest engineering bodies, is the procuring of men for special government service. A tabulation is also being made of the members of the societies represented, for use in the industries, especially after the war is over. In organizing the council, provision was made for the election to membership of other national engineering and technical societies. The office of the council is in the Engineering Societies Building.

How To Reduce Coal Requirements.

A bulletin issued by the Chamber of Commerce of the United States emphasizes the following suggestions for reducing the coal requirements during the coming winter:

1. Inquire into the methods employed by your fireman and consider his methods in relation to those suggested by the Bureau of Mines.
2. Learn what plants in your locality secure the best results from coal.
3. Endeavor to have the wasteful users of coal profit by the best experience in the locality.
4. Improve all local methods by consultation with the Bureau of Mines and Study of the Stoking Methods Recommended by the Bureau.
5. Buy your coal as near home as possible.

As has already been announced, President Wilson, acting under the Food Control act, has fixed the prices of bituminous coal, f.o.b. mine, at from $2 to $3.50 per ton of 2,000 lbs., classified as to size, quality and locality. Jobbers in bituminous coal are permitted to add not over 15 cents a ton.

The maximum prices for anthracite coal for certain specified producers, f. o. b. mine, were fixed at from $4 to $4.30 per ton of 2,240 lbs., classified as to size, quality and production. All producers not specified are allowed to sell at prices not over seventy-five cents a ton higher than the prices fixed by the President.

Anthracite jobbers in Buffalo or east of that city, may add not more than twenty cents a ton of 2,240 lbs. to their purchase price; and jobbers west of Buffalo may add a gross margin of thirty cents per ton.

President Harry A. Garfield, of Williams College, has been appointed Fuel Administrator with power to execute the orders issued by the President.

The President has also appointed an administrative officer under the Priority Shipments Act to supervise shipments of coal. Certain railroads have been directed to ship bituminous coal to Lake Superior and Lake Michigan ports in order that it may be sent to the Northwest to supply the needs of that portion of the country.

In a statement issued by President Garfield he states:

"Until further direction, the following rulings will be observed:

"1. The President's order fixing prices became effective for bituminous coal Tuesday evening, August 21, 1917; for anthracite coal, Saturday, September 1, 1917. The President's order includes export and bunker coal.

"2. The prices fixed are provisional. They will stand unless changed by order of the President, for good cause shown. The Fuel Administration will examine all applications for revision of prices accompanied by cost statements presented in writing. These statements should be verified and cover at least the years 1915, 1916 and 1917, to date.

"If further explanation is needed the Fuel Administration will ask complainants to appear in person.

"It is not proposed to require efficiently operated mines to produce coal at a loss, but the burden rests upon applicants to show that the prices fixed in particular cases are unfair.

"3. It will greatly expedite the work of the Fuel Administration if associations, whether of operators, miners or industries affected, would postpone the holding of meetings for the appointment of committees to confer with the Fuel Administrator, or for the purpose of taking action concerning prices and wages, until he has had opportunity to select his advisers and hear from those who believe themselves likely to be adversely affected. Prompt atention will be given to all communications.

"4. Plans are under consideration and will be soon announced, whereby production may continue without affecting adversely either the producer or the purchaser pending the examination of applications for revision of prices. Until this plan is announced, it is suggested that sales and deliveries be made at the prices fixed with a stipulation to the effect that if prices are readjusted settlements shall be made accordingly.

"5. For the purpose of determining a proper basis for sales by retail dealers, local committees will be organized throughout the country. Each committee will investigate and report upon the local situation and advise concerning the regulations to be established. When the price is fixed the local committee will be asked to superintend its enforcement.

"6. The Fuel Administration is preparing a plan of apportionment which will secure to domestic consumers their fair share of the coal supply and at prices which will reflect the prices heretofore promulgated by the President.

"7. Contracts relating to bituminous coal made before the proclamation of the President on August 21, and contracts relating to anthracite coal made before the President's proclamation of August 23, are not affected by these proclamations, provided the contracts are bona fide in character and are enforceable at law.

"The undersigned has requested the Federal Trade Commission to secure at the earliest moment possible a certified copy of all contracts held to come within the foregoing rule."

An announcement issued by the Fuel Administration under date of October 1, fixed the retail prices of anthracite and bituminous coal, but these may undergo further revision in view of the coal strikes.

Government Orders.

American Radiator Company, it is reported, has been negotiating with the government with a view of turning over its plant at Bayonne, N. J., for the manufacture of guns. It is stated that this plant is at present engaged in filling government orders for naval guns. These orders, it is added, approximate $3,000,000 and will take from six to eight months to complete.

Hudson Boiler Mfg. Co., New York, has received an order from the War Department for a large number of hot water heaters for use in the army cantonments.

Kewanee Boiler Co., Kewanee, Ill., it is stated, has received orders from the government for heaters, boilers, tanks and garbage burners, approximating in value $912,000, with the prospect of more orders to come. These supplies will be used in the army cantonments, officers' training stations, aviation camps, etc.

Ilg Electric Ventilating Co., Chicago, Ill., has organized its office and factory employees into a military company. Drills are held every day at noon in front of the company's plant at 154 Whiting Street. A uniform style of working clothes has been adopted consisting of a khaki-colored oversuit.

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American Association of Engineers.

Local chapters of the American Association of Engineers have been established in St. Paul, Indianapolis and Milwaukee. This makes a total of seven chapters which have been organized since the formation of the association, two years ago. The total enrollment of the association is now over 2,200 members.

Manufacturers of Smokeless Boilers.

The following list contains the names of manufacturers of smokeless boilers. This list shows some notable additions to that published last year and there are several firms which, though not at present making smokeless boilers, have plans fully matured for taking up this line. Two such typical firms are the Richmond Radiator Company, of New York, and the Thatcher Furnace Company, of New York.

LOW PRESSURE STEAM AND HOT WATER BOILERS.

American Radiator Co., Chicago, Ill.
John Brennan & Co., Detroit, Mich.
Coatesville Boiler Works, Coatesville, Pa.
Jesse C. Coogan, Milwaukee, Wis.
Federal Radiator Corporation, Newcastle, Pa.
Gurney Heater Mfg. Co., Boston, Mass.
Harrisburg Mfg. & Boiler Co., Harrisburg, Pa.
Hart & Crouse, Washington, D. C.
Herbert Boiler Co., Chicago, Ill.
Ideal Heating Co., Oskaloosa, Ia.
Kanawha Mfg. Co., Charleston, W. Va.
Kellogg-Mackay Co., Chicago, Ill.
Kewanee Boiler Co., Kewanee, Ill.
Molby Boiler Co., New York.
Newport Boiler Co., Chicago, Ill.
Wm. H. Page Boiler Co., New York.
Peck-Williamson Co., Cincinnati, O.
Peerless Heater Co., Pittsburgh, Pa.
Pierce, Butler & Pierce Mfg. Corporation, New York.
Frank Prox Co., Terre Haute, Ind.
Prudential Heating Co., Akron, O.
H. B. Smith Co., Westfield, Mass.
Spencer Heater Co., Scranton, Pa.
Thompson Heater Corporation, Buffalo, N. Y.
United States Radiator Corporation, Detroit, Mich.
Utica Heater Co., Utica, N. Y.

FIRE TUBE BOILERS.

Ames Iron Works, Oswego, N. Y.
John Brennan & Co., Detroit, Mich.
Brownell Co., Dayton, O.
Casey-Hedges Co., Chattanooga, Tenn.
Freeman & Sons Mfg. Co., Racine, Wis.
Gem City Boiler Works, Dayton, O.
Harrisburg Mfg. & Boiler Co., Harrisburg, Pa.
Hawkes Boiler Co., Chicago, Ill.
Kewanee Boiler Co., Kewanee, Ill.
Murray Iron Works Co., Burlington, Ia.
John O'Brien Boiler Works Co., St. Louis, Mo.
Oil City Boiler Works, Oil City, Pa.
Titusville Iron Co., Titusville, Pa.
Vogt Machine Co., Louisville, Ky.

ACCESSORIES FOR SMOKELESS BOILER OPERATION.

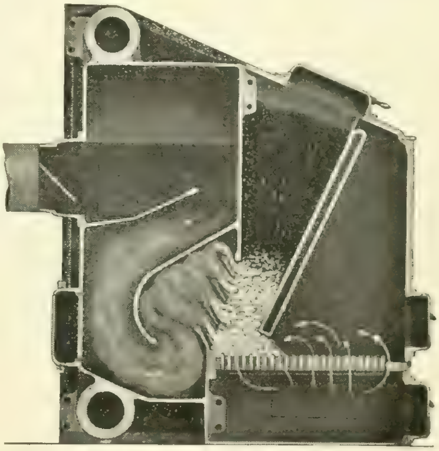
Eureka Smokeless Furnace Co., Chicago, Ill. (Smokeless Furnaces)
Betson Plastic Firebrick Co., Terre Haute, Ind. (Fire Brick)

◆

A New Adjustable Magazine Boiler.

A new type of house-heating boiler, with an adjustable magazine furnace, has been brought out by the Thompson Heater Corporation, Buffalo, N. Y. It is known as the Thompson boiler, being designed and perfected by C. B. Thompson, the president of the company and a well-known writer on heating subjects.

The most striking feature of the heater is the separation of boiler and furnace. With this arrangement, the fuel capacity may be increased without increasing the size of the boiler. The furnace may be adjusted to burn through any desired fuel thickness to accommodate fuels of variable densities. Also, the furnace may be adjusted to burn any kind of fuel without changing the boiler in any way, Finally, the magazine furnace may be adjusted to burn various sizes of hard coal from stove size to buckwheat, as well as soft coal, without smoke.



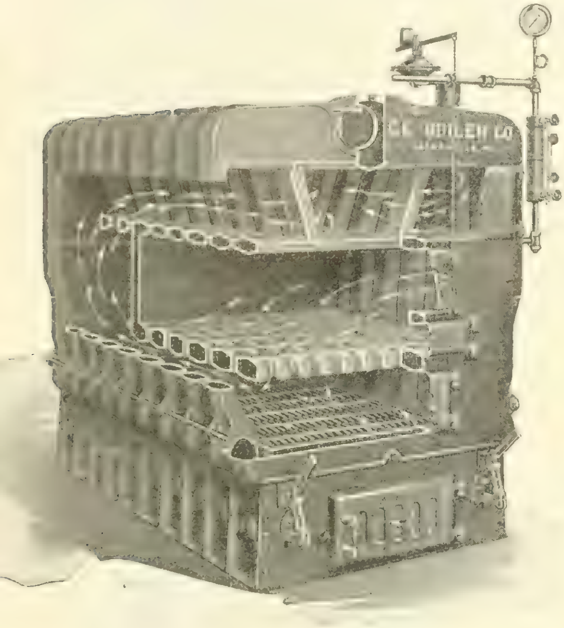
THOMPSON ADJUSTABLE MAGAZINE HEATER—ADJUSTED TO BURN PEA COAL.

In a catalogue published by the company descriptive of this new boiler, tables of boiler capacities are given for the various conditions of operation, worked out in detail according to the latest ideas for rating boilers. Colored photographs are shown of the construction of the boiler and there are also detail views of the center section showing the self-sealing material attached to the flue walls and water-cooled grate attached. Size of catalogue 8 × 11 in. Pp. 19.

◆

Monarch Down-Draft Smokeless Boiler.

A boiler that will burn any soft coal smokelessly, thereby guaranteeing immunity from smoke ordinances and a saving in the coal bill of from 25% to 33⅓%, is the description given of the Monarch down-draft smokeless boiler for soft coal exclusively, manufactured by the Wm. H. Page Boiler Co., 141-145 West 36th Street, New York. This heater has two combustion chambers and grates, one directly above the other.



MONARCH DOWN-DRAFT SMOKELESS BOILER.

The upper grate is cast integral with the boiler section, each bar being hollow, the same as the boiler section of which it is a part. The inside area has been found ample to provide for free circulation and every part is backed with water to prevent any burn-out. The spaces between the grates and their hollow projections are proportioned to allow for the passage of the requisite supply of air for complete combustion. The water grate also forms an effective part of the heating surface in the boiler.

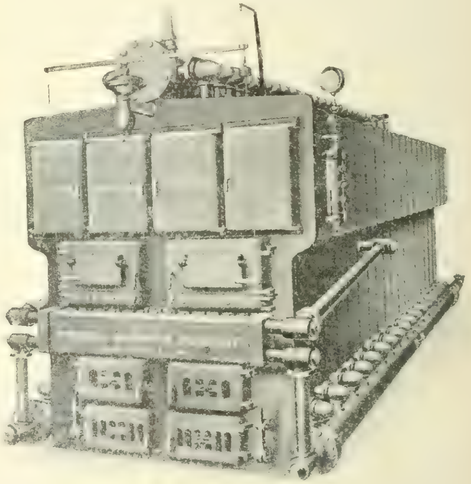
In the operation of this boiler, no fuel supply is required for the lower or secondary grate, the upper grates only being charged.

The Monarch boiler, it is stated, is particularly advantageous in sections where natural gas burners are used, as their installation in a building is an insurance against the time when the gas supply may become exhausted temporarily or permanently through accidents to mains, freezing, etc., as the disconnection of the gas burners, easily accomplished, permits the substitution of soft coal for fuel. Almost every style of gas burner is adapted to these boilers, making their convertibility an important feature. The boilers are made in a wide variety of sizes for either steam or hot water, the steam capacities running up to 9,000 sq. ft.

◆

Three Characteristic Principles of the Federal Water-Tube Smokeless Boiler.

A smokeless boiler that embodies the features of the Hawley type of down-draft furnace, water-tube construction and a secondary combustion chamber, has been brought out by the Federal Radiator Co., New Castle, Pa. Of these three features, special emphasis is laid on the secondary combustion chamber, as it is considered that this is just as essential in order to complete combustion and the uniting of the hydrocarbon gases, as to have a down-draft principle of burning the coal. The hydrocarbon gases, after passing the bridge wall, must expand and must be advanced to a higher temperature. This, it is claimed, can not be accomplished successfully unless



FEDERAL WATER-TUBE SMOKELESS BOILER.

a large secondary combustion chamber is constructed so that these gases will not chill.

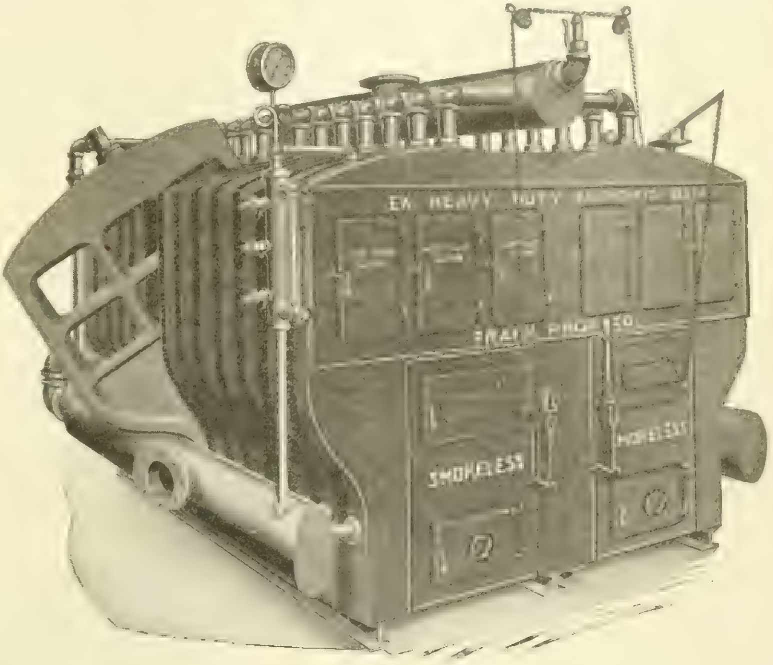
The large combustion chamber which is built without any obstruction, the Hawley type of down-draft furnace and the water-tube construction, combined with water space and steam-liberating space large enough to produce a steady condition of the water are among the advantages of this heater. The type of grate is such that it is possible to burn from 1 to 25 lbs. of coal per square foot of grate per hour. Any grate of soft coal may be used, it is stated, with smokeless results, high efficiency, and high evaporating power and in addition, the boiler may be overloaded when necessary.

By referring to the illustration it will be noted that the Federal boiler is of cast-iron sectional construction. Each section is made in two parts. The water-grate is in single units. No joints are exposed to the fire and any section or grate can be removed without disturbing the balance of the boiler. The boiler is made up to 20,000 sq. ft. in single units, all of the ratings, it is added, being based on actual evaporation. Bulletin 17, issued by the company, is devoted to this boiler and contains interesting details of its construction and operation.

◆

Types of Heavy-Duty Smokeless Boilers.

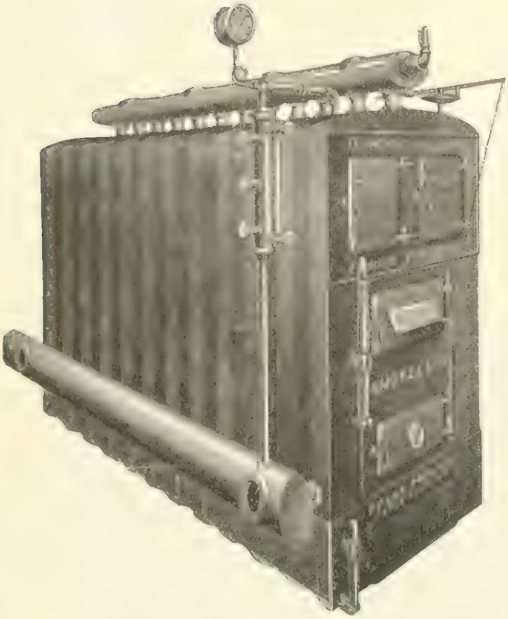
A line of down-draft boilers designed for heavy duty, has been brought out by the Frank Prox Co., Terre Haute, Ind., under the names of the "Smokeless" Economic extra-heavy and the Duplex Economic Heavy-Duty down-draft boilers. Of these two lines, one is known as the single-grate and the other as the double-grate type. The single grate boiler has the Prox patented rocking grate and the manufacturers state that this is the only down-draft boiler having a rocking grate. This rocking grate is mounted on a hollow bar which, being part of the section, has the same circulation of water, and is operated by shaker levers. The advantage of the rocking grate over the stationary type is that, with the rocking grate, the fire can be stoked uniformly, giving the entire area of the grate the same working condition and thereby increasing the efficiency.



SMOKELESS DUPLEX ECONOMIC EXTRA-HEAVY DOWN-DRAFT STEAM BOILER (SINGLE GRATE).

The double-grate boilers are made with the stationary or rocking grates on the upper grate and rocking grates on the lower.

In all Prox down-draft boilers the upper grate, or grate tube, is a part of the section and has the same circulation of water as the section itself. It also makes erecting easy. The upper grate is designed to carry the water circulation, as it enters the bottom of the section, right across the downward travel of the burning gases. Excessive expansion and contraction at this point is provided for. Each type of boiler is made in two complete series, the data for which are given in one of the company's recent catalogues.



SMOKELESS ECONOMIC DOWN-DRAFT STEAM BOILER, WITH DOUBLE GRATE.

Success of the Imperial Smokeless Boiler.

The notable number of successful installations of the Imperial smokeless boilers, made by the Utica Heater Co., Utica, N. Y., especially in the locality of Chicago and vicinity, has brought this type of heater prominently before the trade. As its name implies it is designed to burn the cheapest grades of soft coal without producing objectionable smoke and the manufacturers state that they have yet to find a single instance where one of these boilers has failed to comply with the most rigid smoke ordinance, while using any grade of soft coal.

Aside from the special construction of the Imperial boiler, the arrangement of the double grates is mentioned as the secret of its success. Fuel is fed to the upper grate. Partially-consumed coal drops from the upper to the lower grate, thus giving a double fire, one with a down draft and the other upward, the two meeting with intense combustion. The special water grate used with this boiler is also included among its important features. Directly opposite the water grate on each section are placed 1¼-in. brass plugs to assure thorough extraction of all foreign matter and to provide easy access for inspection and cleaning.

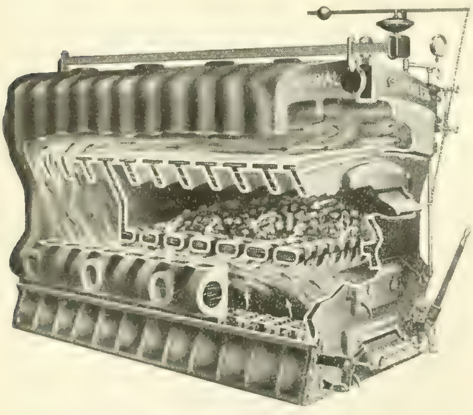
This line is made in a 30-in. series and a 40-in. series for steam and water.

◆

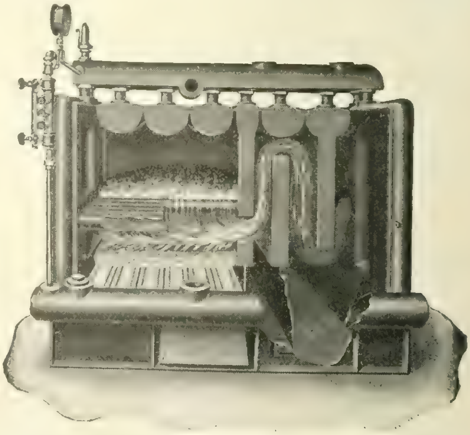
A Header-Type of Down-Draft Boiler.

An unusually long fire-travel, combined with an effective arrangement of heating surface, water tubes and grates, are the outstanding features of the Gurney down-draft smoke-consuming boiler, which is a product of the Gurney Heater Mfg. Co., Boston, Mass. This boiler embodies all of the well-known features of the Gurney Bright Idea water-tube construction. As will be noted from the illustration, these boilers are of the header type, affording a large steam reserve space, and the headers are connected to the sections by extra-heavy 3-in. nipples, with lock nuts.

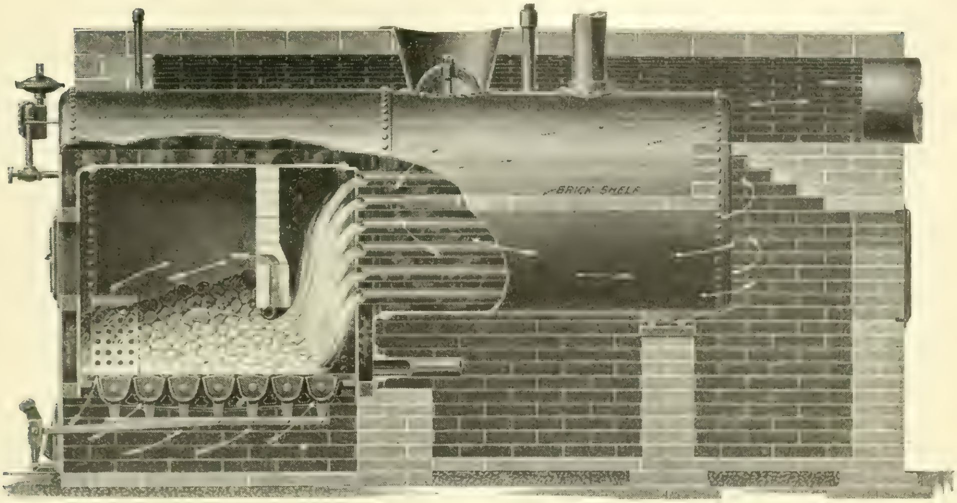
Among the details of construction may be mentioned the openings between the sections in the bottom of the gas-making chamber which afford easy access to the slice bars for cleaning without disturbing



CONSTRUCTION OF IMPERIAL SMOKELESS BOILER.

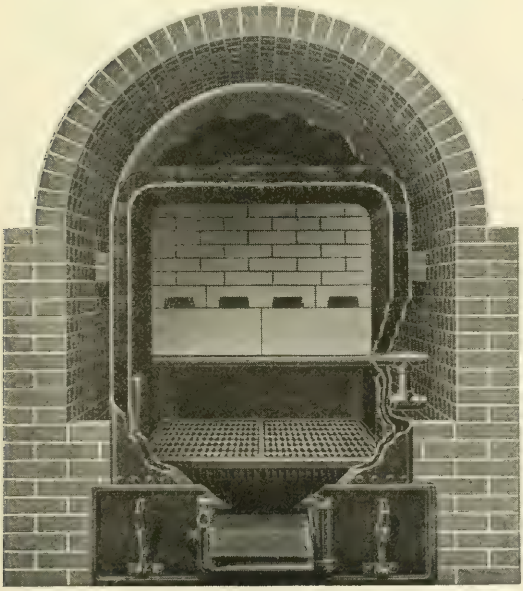


GURNEY DOWN-DRAFT SMOKE-CONSUMING BOILER.



METHOD OF INTRODUCING SUPERHEATED AIR IN COMBUSTION CHAMBER OF EUREKA SMOKELESS FURNACE.

the fire. Also ample space is provided in the gas chambers for the complete combustion. Finally, the water-travel is vertical, following its natural course. The company's catalogue contains dimensions, capacities, etc., for both the steam and water series, as well as a table of stack sizes for down-draft sizes, running from a 40-ft. chimney height for a 1,200-1,500 sq. ft. boiler to 100 ft. for a 14,500-15,000 sq. ft. boiler.



EUREKA SMOKELESS FURNACE INSTALLED IN ORDINARY FIRE-BOX BOILER.

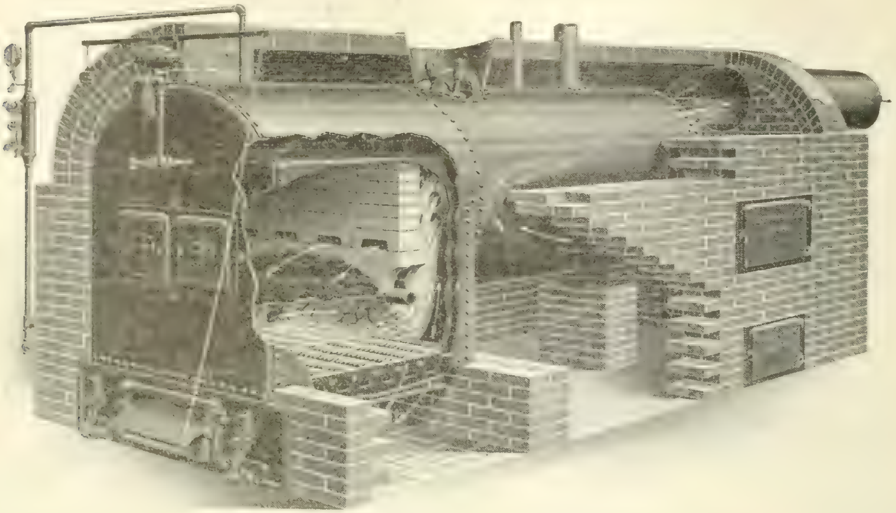
Features of the Eureka Smokeless Furnace.

Basing its claims on the point that an even distribution of air is quite as essential as the correct amount of air, the Eureka smokeless furnace is presented to the trade as being able to increase the efficiency of any boiler in which it is installed; that will burn Illinois or Indiana coal in full compliance with the city smoke ordinances; that will save at least one-fourth of the usual fuel cost; that will run automatically on three to five firings per day and maintain satisfactory pressure of steam or vapor; and, finally, that will burn more air and less coal than other furnaces. Regarding the air distribution it is stated that hot air is not only distributed over the coal bed, but is also injected into the gas chamber back of the hollow Eureka fire wall, where all gases become ignited and consumed, at a high temperature, before entering the boiler tubes.

The fact that the Eureka smokeless furnace is endorsed and commended by the Chicago Smoke Bureau is an interesting commentary on the efficiency of this heater, especially as the manufacturers had nothing to do with the tests on which the endorsement was based. One of the catalogues, "A Burning Question," contains a full report of the test. The manufacturers are the Eureka Smokeless Furnace Co., 1215 Chamber of Commerce Building, Chicago, Ill.

"Oil City" Smokeless Boilers.

An effective design for a smokeless re-

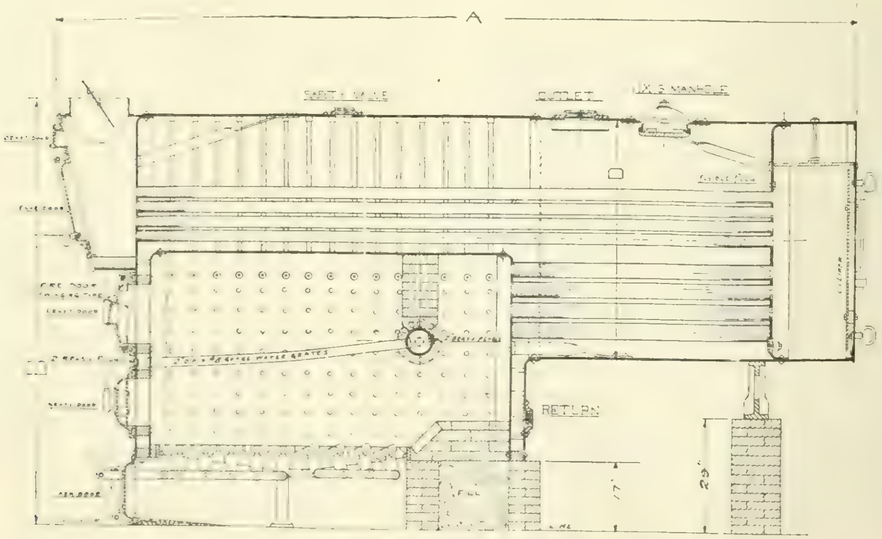


ARRANGEMENT FOR ADMITTING AIR THROUGH EUREKA DEVICE AND THE SUBSEQUENT PASSAGE OF GASES.

turn-tubular fire-box boiler has been developed by the Oil City Boiler Works, Oil City, Pa., as shown in the accompanying illustration. This boiler is of the self-contained type, and is fitted with a water or down-draft grate, for the abatement of smoke. It is designed to meet the requirements of laws adopted by many of the larger cities for the elimination of the smoke nuisance.

It will be noted that the boiler is really a combination of the principal features of the locomotive and horizontal tubular boilers. The return flues of the horizontal tubular type are added to the internally-fired locomotive type, while at the same time the brickwork is eliminated.

The furnace is surrounded by a steel water-jacket. Coal is fired on the upper or water grates. The products of combustion pass downward over the fire on the lower grates and thence through the tubes. Care is taken to prevent short circuiting or dead corners. The tubes are small in diameter which permits them to be made of a uniform thickness of metal.



LONGITUDINAL SECTION

CONSTRUCTION OF "OIL CITY" SMOKELESS BOILER

Another point mentioned for this boiler is that all the heating surface is easily kept clean.

Behind the "Oil City" smokeless boiler is the organization of the well-known Oil City Boiler Works. The boilers are built of flange steel, instead of tank steel and the manufacturers lay stress on the high character of the workmanship used on this line. The sizes run from capacities from 2,000 sq. ft. to 16,000 sq. ft. of direct steam radiation. A circular issued by the company gives these and other details.

◆

A Portable Pitot Tube for Gases.

A Pitot tube designed for blower testing, ventilation work, testing of flow of gas in mines, aeroplane testing, foundry blowers, or any application where it is desired to determine the velocity of air or gas, has been brought out by A. H. Anderson, mechanical engineer, 3,300 Federal Street, Chicago, Ill. This form of Pitot tube originated and was developed in the laboratories of the Armour Institute of Technology, Chicago.

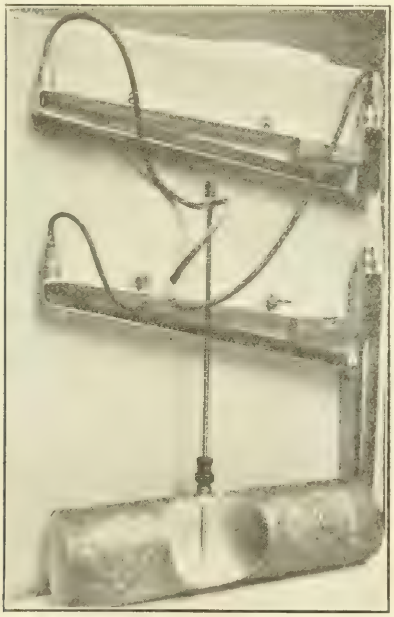


FIG. 1—PITOT TUBE AND TWO DIFFERENTIAL GAUGES. PIPE CUT AWAY TO SHOW TIP OF TUBE.

The tube is so compact that it may be inserted or withdrawn through the stuffing box without inclination of the tube. The stuffing box prevents leakage, and also clamps the tube in any position desired.

The scale engraved on the stem of the tube indicates the distance the tip of the tube projects into the pipe. The two arms at the top indicate the direction in which the tip is pointed; when these arms are placed at right angles to the pipe, as nearly as can be judged by eye, the results will be accurate within a very small percentage. One arm is stamped "S" for the static opening; the other is stamped "D" for the dynamic opening. Each of these arms is connected by rubber tubing to the proper end of the differential gauge.

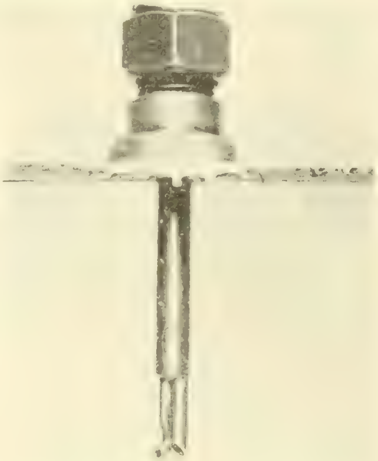


FIG. 2—ENLARGED VIEW OF TIP OF TUBE, SHOWING STATIC AND DYNAMIC OPENINGS.

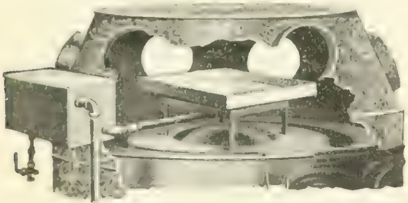
An instruction sheet accompanies each tube, illustrating the application to various gases. A list of constants is given for different temperatures, pressures, humidities, and kinds of gas, and computation is reduced to a minimum.

Each tube is carefully calibrated for the range of velocities for which the tube is to be used.

◆

An Automatic Humidifier for Warm-Air Furnaces.

An adaptation of the Buddington humidifier used on radiators, to warm-air furnaces, is announced by the Reid-Geisler Mfg. Co., 5238 Ravenswood Ave., Chicago, Ill. It is stated that one Buddington automatic humidifier, as made for use in furnaces, will moisten the air throughout the ordinary house. The humidifier is connected to the city water supply and automatically refills itself as the water is evaporated. It can be installed in practically any warm-air furnace. It consists of a vitrified enamel evaporating pan which rests on top of the dome over the fire-box, where it gets the maximum heat. This is connected by a water pipe to the water chamber, which is suspended from the ceiling, or placed on a suitable shelf outside the furnace. Inside of the chamber is a float valve which keeps the water level equal in this chamber and in the evaporating pan.



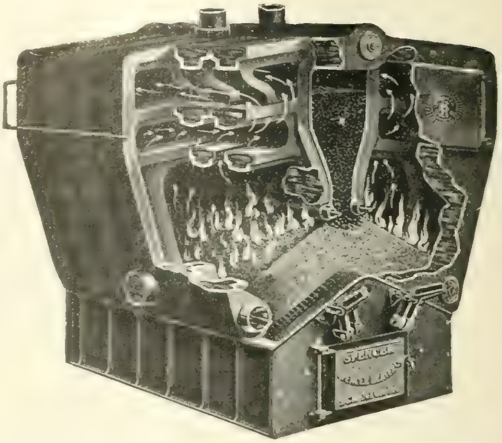
BUDDINGTON HUMIDIFIER AS ADAPTED TO WARM-AIR FURNACE.

This device is intended to automatically mix just the proper amount of moisture with the heat, operating in direct proportion to the amount of heat generated. It is made in two sizes.

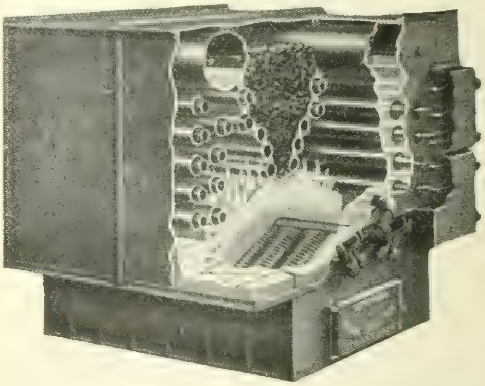
◆

Trade Literature

Spencer Super-Standard Heaters, adapted for steam, vapor or hot water and combining the advantages of magazine-feed, sloping grate construction and ability to burn low-priced coal, including bituminous, are brought to the attention of the trade in a comprehensive catalogue that takes up in detail all the important features of construction and operation of this heater. One section of the catalogue is given over to "the Spencer's superior economy in coal bills," based on its magazine-feed and sloping grates. In the second section, the automatic action of the heater, designed to reduce both coal cost and human labor to a minimum, are explained, there being no shoveling of coal on the surface of the fire, while the sloping grates permit the coal to be distributed evenly. One of the unique features of this heater is that its magazine has a water-jacket on its outside, adding to the water exposure and at the same time keeping the coal cool till wanted. An important advantage of the sloping grate construction is that the two sections are independent of each other so that the fire on one section may be kept up and that on the other section allowed to go out, if desired, as in mild weather. All of the Spencer water heaters are made in sectional form, but the steam and vapor boilers are built of special "Spellerized" tubes, straight, parallel and nearly horizontal. This construction follows in general the lines of high-pressure boilers and is designed to gain greater efficiency and economy of operation. Special views are included showing how the various parts are designed and assembled. The steam heaters are made with double tubes, the outer tube conveying the water and the inner tube the gases, with direct heat from the fire playing on the outer tubes. Typical buildings of various types are shown, accompanied with copies of letters from owners who have had Spencer heaters installed. Under "Further Facts of Importance," hints are given on the selection and installation of these heaters, records from university and other tests, valuable hints on chimney construction and engineering data on factors determining boiler capacities. Price lists are also included for each size and type. The manufacturers are the Spencer Heater Co., Scranton, Pa. Size of catalogue 8½ × 11 in. (standard). Pp. 40.



SPENCER HOT-WATER HEATER SHOWING SLOPING GRATE CONSTRUCTION.



SPENCER STEAM HEATERS ARE MADE WITH DOUBLE STEEL TUBES.

Chimneys

Note:—The following tables and memoranda on chimneys are selected from a discussion of the subject by Harold L. Alt, which appeared in THE HEATING AND VENTILATING MAGAZINE *for March and April, 1917, and to which the reader is referred for more complete information.*

The most common error made in regard to chimneys is that of not distinguishing between the size (which governs the volume of smoke they can handle) and the height (which determines the intensity of the draft). A chimney may be *high* enough yet with an *area* too small to do the work required. On the other hand it may be *large* enough but too *low* to produce a *draft* of the strength required to pull the air through the fire and up the chimney at a sufficiently rapid rate. Either fault, or a combination of both, will result in unsatisfactory service and will require remedying.

Heated air expands and occupies a greater volume than the outer air of a lesser temperature, so if a cubic foot of air outside the chimney weighs 0.07 lbs. and a cubic foot of the chimney gases at their higher temperature weighs only 0.04 lbs. then every vertical foot of air in the chimney means an unbalanced pressure of 0.07 — 0.04, or 0.03 lbs. per square foot at the base. This unbalanced pressure has a tendency to equalize by the rising of the lighter gases but since their place is taken by more heated gases coming directly from the fire the temperature, of course, never does equalize and the action continues its operation as long as the fire is kept burning.

From this basic principle all chimney action is governed and many chimney failings can be explained. For instance, the draft of a chimney is never as good in summer as in winter because the outside air is colder in the winter, the expansion of the chimney gases at the same temperature is, therefore, relatively greater and the intensity of the chimney draft is consequently increased.

Chimneys have to overcome their own losses, these losses consisting of the friction of the gases rubbing against the sides in their upward passage. For this reason a *circular-shaped flue* is most desirable, the next, square, and after that oblong with the *long* side *not more* than *double* the length of the *short* side. In flues where it is necessary to exceed this proportion *two* separate flues of more desirable shape can sometimes be used with advantage.

The most efficient chimney, as far as draft is concerned, is one built perfectly straight from the bottom up, round (or nearly round) in the shape of the interior flue, and lined with tile, or with the interior surface made as smooth as possible by other means. There is no advantage in tapering the inside of a chimney to a smaller size toward the top—this only retards the flow of the gases.

A square chimney can hardly be figured as having its full area effective, a *deduction* of 10% to 15% being necessary on account of the spiral movement of the gases leaving the corners dead and inactive. With an oblong shape the effect is worse, a deduction of 25% being none too much. The use of tile flues will not only aid this slightly, owing to their rounded corners, but will also safeguard much of the fire risk otherwise due to mortar falling out between the bricks as time passes and leaving openings through which a spark might pass. As the tile serves to retain the gases and smoke it also prevents leakage which can spoil a chimney action at any time, no matter how perfectly the flue may otherwise be built.

RESIDENCE CHIMNEYS

The ordinary residence usually employs a chimney between 25 and 60 ft. high, the area being proportional to the size of the house and it is interesting to note that it is possible to burn No. 1 buckwheat coal with a chimney 55 ft. high, if the fire bed is not made too thick. Down-draft boilers should have chimneys at least 60 ft. high to operate successfully.

Having a chimney built upon desirable lines, as far as draft is concerned, it may, of course, still be too small, and in this connection it might be said that no flue should be made *less* than 8 in. diameter or 8 in. × 8 in. square. Under ordinary conditions, with steam, furnace or hot water heating, the following sizes of flues given in the table will be found to give satisfaction in residences whose cubic footage does not exceed the amounts shown:

SIZES OF FLUES FOR RESIDENCES.

Cubic Contents of Building. Cubic Feet.	*Round.* Inches Diam.	*Square.* Inches.	*Oblong.* Inches.
20,000	8	8 × 8	6 × 10
40,000	9	9 × 9	8 × 12
60,000	10	10 × 10	8 × 14
110,000	12	12 × 12	10 × 18
120,000	14	14 × 14	12 × 18
130,000	16	16 × 16	12 × 18
150,000	18	18 × 18	14 × 20

When flue tile is used the interior dimensions are not in even figures, the exact dimensions of commercial sizes being given in the table below:

COMMERCIAL SIZES AND AREAS OF FLUE TILE.

Square or Oblong Outside Dimensions, Inches.	Circular Inside Dimensions, Inches	Area Sq. in.
..	8	50
8½ × 8½	..	52
..	9	64
..	10	78
8½ × 13½	..	80
..	11	95
..	12	113
13 × 13	..	126
..	13	133
13 × 18	14	154
..	..	169
..	15	177
..	16	201
..	17	227
18 × 18	..	240

RESIDENCE CHIMNEYS

When square or rectangular chimneys are designed for fire places which burn wood or bituminous coal they are usually made with an area of 10% to 12% of the fire place opening, while with round flues the area may be reduced to 8%. For anthracite coal the rectangular or square flue may be reduced to 8% and the round flue to 6%. Ordinary stoves are readily served with an 8 in. × 8 in. flue, provided no other connections are made to it.

All chimney walls should be 8 in. thick to avoid danger of fire from sparks working through the joints, and the building laws in some cases demand not only 8 in. thick walls but tile linings as well.

The *height* of residence chimneys, as before mentioned, is usually of small moment, since the use of larger sizes of anthracite coal is common under such conditions. The draft, however, ought to approximate in inches of water the various values given in the table below after being in use twenty-four hours and with all the inlets suddenly closed.

DRAFT IN CHIMNEYS FOR RESIDENCES.

	Temperature of Outgoing Gases, Deg. F.		
Height in Feet.	200	250	300
	Inches	of	Water
60	0.27	0.32	0.35
55	0.25	0.29	0.32
50	0.23	0.26	0.29
45	0.21	0.23	0.26
40	0.18	0.21	0.23
35	0.16	0.19	0.20
30	0.14	0.16	0.17
25	0.12	0.14	0.14
20	0.09	0.11	0.12

The figures given are about 90% efficiency of the theoretical draft which an absolutely tight chimney would show and a properly constructed chimney should approximate these figures.

CHIMNEYS

The first factor to develop in determining the proper diameter and height of the chimney required is the maximum number of pounds of coal burned per hour and the number of pounds of air required. If the actual boiler horsepower to be developed at the maximum can be computed or assumed the number of pounds of coal for various efficiencies may be read directly from the following table:

REQUIRED POUNDS OF COAL AND AIR FOR HORSEPOWERS AT VARIOUS EFFICIENCIES

Total Lbs. of Coal	POUNDS OF COAL PER BOILER H. P. DEVELOPED							Lbs. of Air per Sec.
	4	4½	5	5½	6	6½	7	
	HORSE POWER DEVELOPED							
50	12	11	10	9	8	8	7	0.25
100	25	22	20	18	16	15	14	0.5
150	17	33	30	27	25	23	21	0.75
200	50	44	40	36	33	31	29	1.0
300	75	67	60	55	50	46	43	1.5
500	125	111	100	91	83	77	71	2.5
750	187	167	150	136	125	115	107	3.7
1,000	250	222	200	182	167	154	143	5.0
1,500	375	333	300	273	250	231	214	7.5
2,000	500	444	400	363	333	308	286	10.0
2,500	625	555	500	455	416	385	357	12.5
3,000	750	667	600	545	500	461	429	15.0
4,000	1,000	889	800	727	667	615	571	20.0
5,000	1,250	1,111	1,000	909	833	769	714	25.
7,500	1,875	1,667	1,500	1,364	1,250	1,154	1,071	38.
10,000	2,500	2,222	2,000	1,818	1,667	1,538	1,429	50.
15,000	3,750	3,333	3,000	2,727	2,500	2,308	2,143	75.
20,000	5,000	4,444	4,000	3,636	3,333	3,077	2,857	100
30,000	7,500	6,667	6,000	5,454	5,000	4,615	4,286	150.
40,000	10,000	8,889	8,000	7,273	6,666	6,154	5,714	200.
50,000	12,500	11,111	10,000	9,091	8,333	7,692	7,143	250.
75,000	18,750	16,667	15,000	13,645	12,500	11,538	10,714	375.
100,000	25,000	22,222	20,000	18,181	16,667	15,384	14,286	500.
125,000	31,250	27,778	25,000	22,745	20,833	19,230	17,857	625.
150,000	37,500	33,333	30,000	27,273	25,000	23,076	21,428	750.
200 000	50,000	44,444	40,000	36,363	33 333	30,768	28,576	1,000.
300,000	75,000	66,667	60,000	54,545	50,000	46,154	42,857	1,500.
400,000	100,000	88,887	80,000	72,727	66,667	61,536	57,143	2,000.
500,000		111,111	100,000	90,909	83,333	76,923	71,428	2,500.
750,000				136,455	125,000	115,380	107,143	3,750.
1,000,000							142,860	5,000.

Note—Include every bend from the boiler uptake to the stack, counting the turn upward in the stack as one bend.

Better heat service with Ideal Specialties

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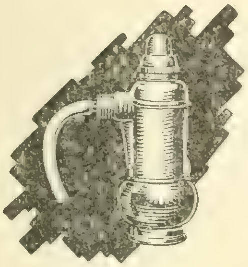

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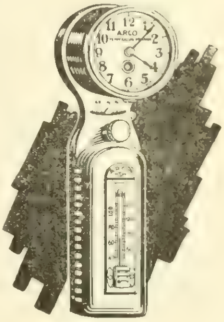

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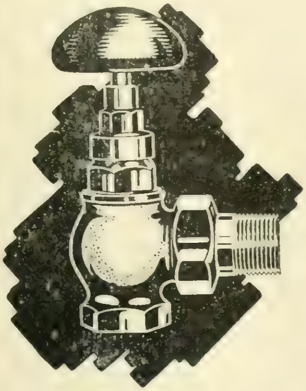

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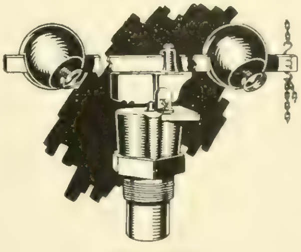

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Trade Literature.

NASH HYDRO TURBINE, described as the most simple compressor and vacuum pump, is the title of a unique circular published by the Nash Engineering Co., South Norwalk, Conn. The cover illustration shows the exterior of the pump and on opening the cover flaps which fold toward the center of the page the interior of the pump is disclosed, showing the principle of operation. The back of the circular shows the other side of the pump from the outside. A short description of the pump is included.

BRAEMER PSYCHROMETRIC CHART, measuring 25½ × 10 in., has been issued by the Braemer Air Conditioning Corporation, Philadelphia, Pa. Special attention is called to the convenient arrangement of the chart which contains printed directions for its use. The chart is intended to be framed or may be placed on a desk under a glass top for ready reference. The company states that the scientific principles upon which the chart is based also govern the Braemer air conditioning and humidity control system.

SYRACUSE PACKLESS VALVES is the subject of an unusually full catalogue issued by the Syracuse Faucet & Valve Co., Eastwood, N. Y. This company specializes in the construction of packless valves. All joints, before they are screwed tight, are lubricated with a mixture of heavy oil and graphite, so that the valve may be loosened without injury to the parts. A large octagon nut is also milled on the lower end of the bonnet to prevent straining the metal of the bonnet in tightening it up. The manufacturers, it is stated, carry a large stock of all standard styles of valves. The illustrations include views of each style of valve, and several pages are also devoted to roughing in dimensions of valves for use in roughing-in job before the valves are received. Size 6 × 8½-in. (folded). Pp. 94.

◆

Death.

Arthur Kneisel, treasurer of the American Association of Engineers, died in Chicago, August 27. Mr. Kneisel had just retired as secretary of the association. He took an active part in its formation. Mr. Kneisel was 37 years old.

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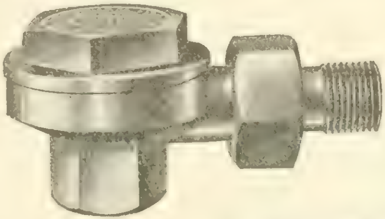

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Investigate. Write for Bulletin No. 5

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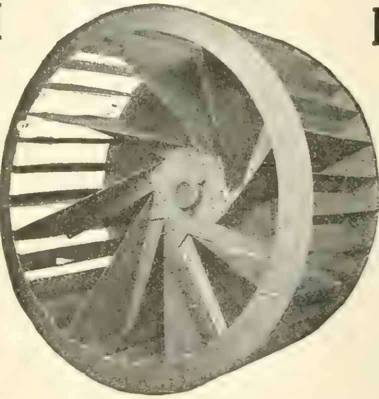

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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. NOVEMBER, 1917 1123 Broadway, New York

TYPICAL BARRACKS IN OFFICERS' RESERVE TRAINING CAMP.

Ventilation of Army Barracks.

A Discussion of the Types Adopted, Together with Suggested Specifications for "Squad Houses."

By W. J. MAUER,
Engineer, Chicago Commission on Ventilation.

(*From a paper read before the Engineering Section of the American Public Health Association, in Washington, D. C., October 18, 1917.*)

Ventilation is a definite problem, although varying under different conditions, and each case has its definite solution. The haphazard method of opening a window here and there is not the solution. The proper arangement of supply and exhaust; the proper allowance of window space for air space; window height for room height; space for occupant, and air distribution and velocity is as definite a problem for the heating and ventilating engineer as the proper proportioning of flange areas and web area in a plate girder is to the structural engineer, or intensity of light, size of opening, and time of exposure is to the photographer.

That some of the vital points on proper housing have in the past been overlooked in the design of barracks is evident from the number of cases of disease that existed in camps.

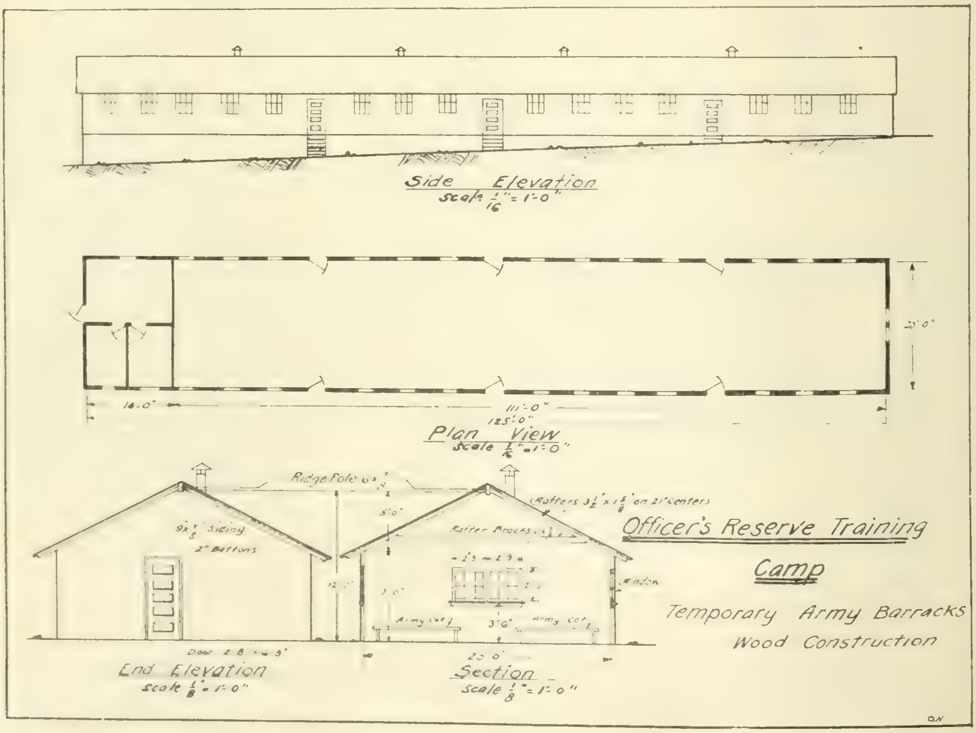
Young men from all walks of life are now concentrating at various training points and as many as 200 are being housed in the same building. If any one of these has measles, mumps, meningitis, pneumonia or other diseases, the entire number in that building may be exposed to the infection, and this is especially dangerous when the air supply is inadequate and other points of sanitation are disregarded.

In a recent article by Frederic J. Haskin, special correspondent for *The Chicago Daily News,* the conditions of the French army in the present war were given. He states that France has discharged 200,000 soldiers on account of tuberculosis since the beginning of the war, and that the spread of the disease in the British army has reached such alarming proportions that the civilian population has organized to combat the situation. This comes at a time when France is making a struggle for existence. The fault is not with the French army but with the French people, and when I say this I mean the French medical and engineering societies. "Before the war the death rate from tuberculosis was nearly three per thousand of population, in the cities the percentage running much higher." The cause was found by the Americans in France who formed a committee for investigation. It was given as *LACK OF FRESH AIR.* The French are far advanced in the science of anaesthesia and surgery, but backward in sanitary matters. The committee proceeded to educate the public on the value of fresh air and now "windows are being sawed in hundreds of peasants' homes which boasted of none before the war. The propaganda of fresh air and sanitation is having its effect."

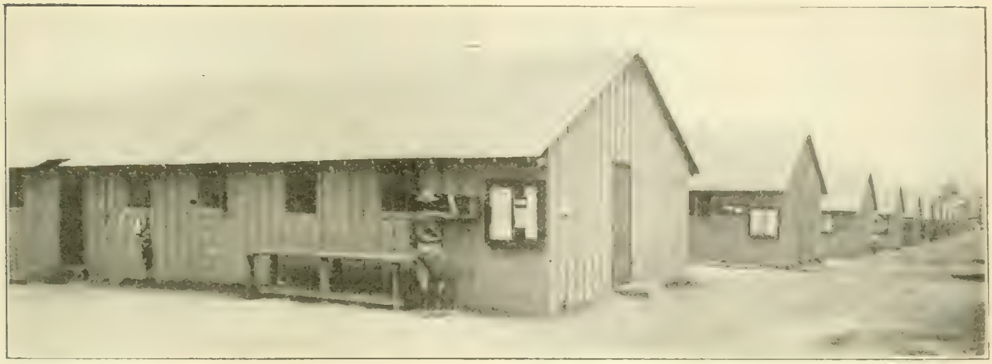
"Nothing has proved more discouraging to the fighting forces in Europe than the verdict of the army physician—'wounded with tuberculosis'—a verdict which should be to Americans both a call for help and a cry of warning."

The science of warfare from a standpoint of destruction of life and property has progressed to a most terrible degree in the present war. The medical profession, too, has made wonderful progress, but the biggest discovery that the medical profession ever made is that "an ounce of prevention is worth a pound of cure."

Longmore's and other tables show that in the wars of the past two hundred years, which were for a prolonged period, 20% of the total deaths were from bullets and 80% from disease, and compar-



TEMPORARY BARRACKS FOR OFFICERS' RESERVE TRAINING CAMP.

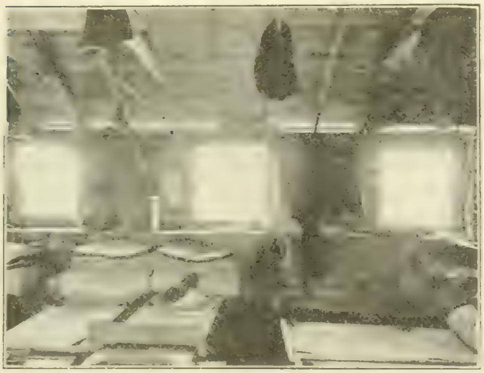


VIEW SHOWING CONSTRUCTION OF BARRACKS AT OFFICERS' RESERVE TRAINING CAMPS.

ing this with our Spanish-American war, 7% of deaths were from bullets and 93% from disease.

SPACE STANDARDS FOR SOLDIERS.

Feeble attempts have been made to establish standards for armies of various countries. The cubic feet of space allowed per soldier in barracks has varied from time to time, and in various countries, but the general tendency has been to increase the space:



DETAIL OF BARRACKS FOR OFFICERS' TRAINING CORPS.
Windows Open Horizontally.

French infantry	421 cu. ft. per soldier.
French cavalry	491 cu. ft. per soldier.
Prussian army	631 cu. ft. per soldier.

The English government found by Royal Commission that 600 cu. ft. was sufficient, provided "local position of barracks be open and airy; the structure of the building simple and admitting free external air and internal movement of atmosphere, and provided the barrack rooms as well as all internal parts of the building are duly ventilated." This shows that the subject has been given some thought, but what engineer would specify "admitting free external air, allow internal movement of air and the building shall be duly ventilated?" This, however, has been made a part of the regulations of the English army. An inspector must inspect monthly, examining the ventilation, heating, light, latrines, closets and all other parts. Besides this, the regiment details a certain number of men to give these points a daily inspection.

MESS HALL, OFFICERS' RESERVE TRAINING CAMP.
Kitchen at Far End. Stove Heat.

HEATING OF BARRACKS.

Shall the men in our army barracks be subjected to extreme changes in temperature and thus become physically hardened?

At first glance it would seem that to prepare an army for war the proper procedure would be to break away from our artificial manner of living and expose our men to heat and cold alike and pick the survivors as those best fit to serve us at the front; in fact, it has been stated there should be no heat supplied to barracks and that the exposure will harden the men and make them more fit for service.

A statement like this is fundamentally wrong and coming, although unofficially, from men in the army it should immediately be argued down. The first tendency for men in a cold room is to close the windows and fill up all openings with papers and rags and thus prevent the free entrance of fresh air and the exhaust of foul. The next inclination is for the men to huddle in one corner of the room and keep warm by an interchange of body heat. The results on health from this kind of housing are too well known to be discussed at this time.

. It might be possible to give orders against the closing of windows and against the crowding of men into corners of the room, as mentioned above, and let us assume that these orders can be followed out to the letter, the following will be the result:

Air that is too cold causes lack of activity, requires more food, causes a lowered vitality, breeds discontent, and the army will show loss of energy and enthusiasm. The argument of "survival of the fittest" is wrong today—the tendency is to conserve and build up.

It is against all good argument and reasoning to house a man in a room

INTERIOR OF BARRACKS FOR OFFICERS' RESERVE TRAINING CORPS.

Heated by Stove in Center.

with a temperature lower than 10° F. above the freezing point of water. A German authority on army camps gives 12° C. or 53½° F. as a minimum.

STEAM HEAT FROM A CENTRAL STATION BEST.

The best system would be steam heat from a central plant and cast-iron wall radiators in the barracks. The temperature should not be too constant, to prevent monotony, and a variation from 45° to 55° F. would be invigorating and conducive to physical activity.

The barracks that are heated by stoves will be subject to considerable drafts. The heat of a stove is local; those being close by will be too warm while those further away will be too cold. A stove requires constant attention and is the source of considerable dust and dirt, not to mention the danger of fire in the building.

BARRACKS AT O. R. T. C.

The barracks that are being built by our government for the care of men enlisted in the Officers' Reserve Training Camps are as follows:

There are four buildings required to house one company, two buildings being used for sleeping quarters, one as mess hall and one for wash rooms, shower room and toilets.

We are chiefly interested in the sleeping quarters or barracks proper. This building as reproduced from measurements and photographs is of wood construction, 125 ft. long and 20 ft. wide. One end is used for office purposes and for officers' quarters and is separated from the remainder of the building by a wood partition extending to the roof. The main portion of the room is used by 80 men and is 111 ft. long.

The roof is quarter pitch, built of ⅞ in. material and covered with roofing felt saturated with asphalt. The sides are ⅞ in. material with batten strips on the outside. The sides are brought within 3 in. of the roof and this space is open, allowing the free admission of air. This space, as well as the doors and windows, are screened.

The windows are 2 ft. 9 in. wide by 2 ft. 11 in. high and there are 28 in the main floor, 13 on each side and 2 at one end. These windows slide horizontally and can be opened their full area.

There are six doors in the main room, 3 on each side. Each door is 32 in. wide by 6 ft. 8 in. high.

The barracks are lighted by electricity with 60 watt lamps, 10 ft. centers, located on the rafters and along the center line of the building.

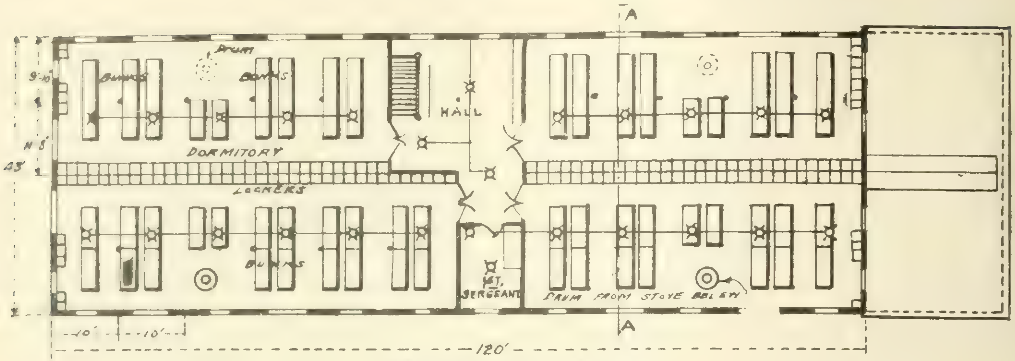
There are four openings in the roof with metal stacks for stove heaters, three being in the main room and one in the office quarters.

The buildings are of open construction and as they now stand would be very unsatisfactory during severe winter weather. This, however, can easily be overcome by lining with wallboard or similar material and allowing an air space between it and the outer wall. The space at the eaves would need to be nailed tight or provision made for opening and closing at will in cold weather.

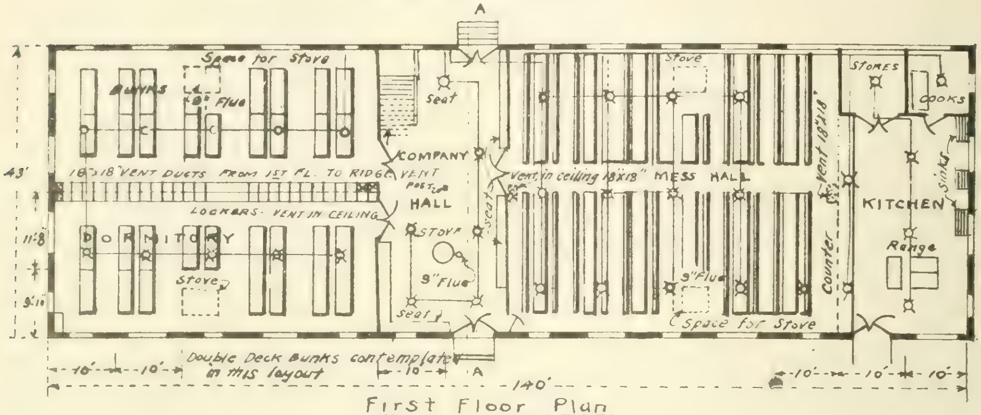
The cots are arranged along the wall, transversely to the room, with the head end about 6 in. from the side wall. The windows are 42 in. above the floor and at this height is a 12-in. shelf against the wall. This shelf is used for books and other personal belongings and serves as a shield for the sleeper's head from the direct draft of the window.

As there are 80 men in the main room, each man has an allowance of 260 cu. ft. of air space, 28 sq. ft. of floor area and 2.8 sq. ft. of window area. Based on the experience of tests made in other buildings it is predicted that the CO_2 will run as high as 12 parts per 10,000.

There is no provision for wardrobe, and a rafter on alternate roof trusses makes a convenient place for the men to hang their clothing. This is clearly shown in the accompanying picture. The dust will run high and if the clothing is



Second Floor Plan

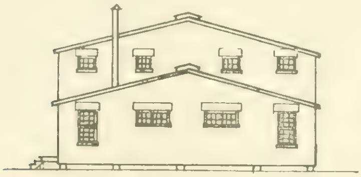


First Floor Plan

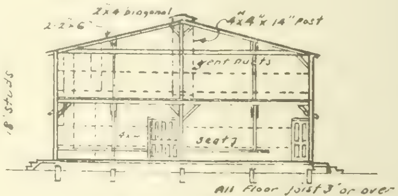
COMPLETE LAYOUT OF A STANDARD COMPANY BARRACKS MEN BOTH SLEEP AND EAT IN THIS WOODEN FRAME BUILDING.

TYPICAL BARRACKS FOR DRAFTED MEN.

Original Plan was for 200 Men. This was changed October 1, 1917, to House 150 Men.



End Elevation
KITCHEN END



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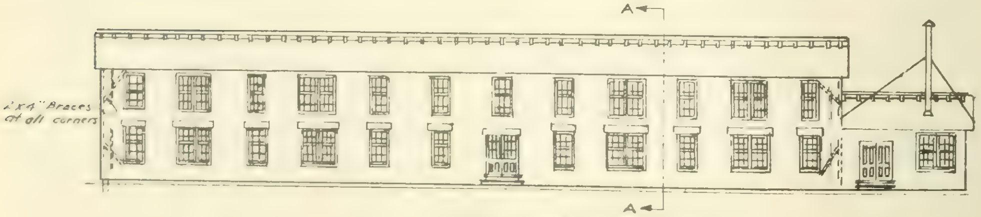


Front Elevation

CONSTRUCTION OF BARRACKS FOR DRAFTED ARMY.

damp there will be considerable odors. But the dangerous feature of this practice is the possibility for the spread of disease germs.

The cots are too close together. They are the standard army canvas top cots being 6 ft. 6 in. long, 27 in. wide and about 14 in. from the floor. They are arranged in pairs, 17 in. between pairs, which gives 6 ft. centers of pairs.

The interior of the barracks are smooth-finished but have not as yet been painted or whitewashed.

At each entrance is a shoe scraper about 30 in. long and 20 in. wide, built of 2 in. by ⅞ in. wood strips set vertically with ⅞-in. space between them. This scraper also serves as a door step. It is an excellent device for cleaning the shoes before entering the barracks and helps considerably to keep down the dust.

BARRACKS FOR THE DRAFTED ARMY.

The plans for the barracks for the army of drafted men were disclosed this summer and are shown herewith, as reproduced from the *Engineering News Record* of July 5, 1917. These are somewhat different from the barracks just described. They are two stories high with sleeping quarters for 200 men and each containing its own kitchen and mess room, while the toilets are in separate buildings. The plans have now been changed to house 150 men in these buildings.

Each barrack is 43 ft. wide and 140 ft. long, 20 ft. of which is but one story high and is used as a kitchen. The ceilings are 9 ft. high. On the first floor is a room with 32 double deck bunks, another room as the company hall, and next to this the mess hall with the kitchen at the end. On the second floor are two rooms for sleeping purposes, one for 36 bunks and one for 32 bunks. Between these two rooms are the first sergeant's office and a large hall. Double-deck bunks are contemplated.

The buildings are of wood construction with metal roofs. The side boarding must give a 15-in. clear space above the ground or be carried down to the ground all around.

Lockers are provided in the sleeping quarters and located in the center of the room so as to divide the room into two parts. On the first floor, space is provided for four stoves. The smoke pipe of each stove is provided with a drum on the second floor.

There will be eight vent ducts 18 in. x 18 in. set in pairs and extending from the first floor ceiling to the ridge vent. The ridge vent runs the entire length of the building.

With 200 men there is an allowance per occupant of 300 cu. ft. of air space, 33⅓ sq. ft. of floor area and 4.5 sq. ft. of window area, while with 150 men there is an allowance per occupant of 400 cu. ft. of air space, 44 sq. ft. of floor area and 6 sq. ft. of window area. It is predicted that the CO_2 will run 10 parts per 10,000 unless the windows are very carefully adjusted. The windows are of the double-hung vertical sliding-sash type.

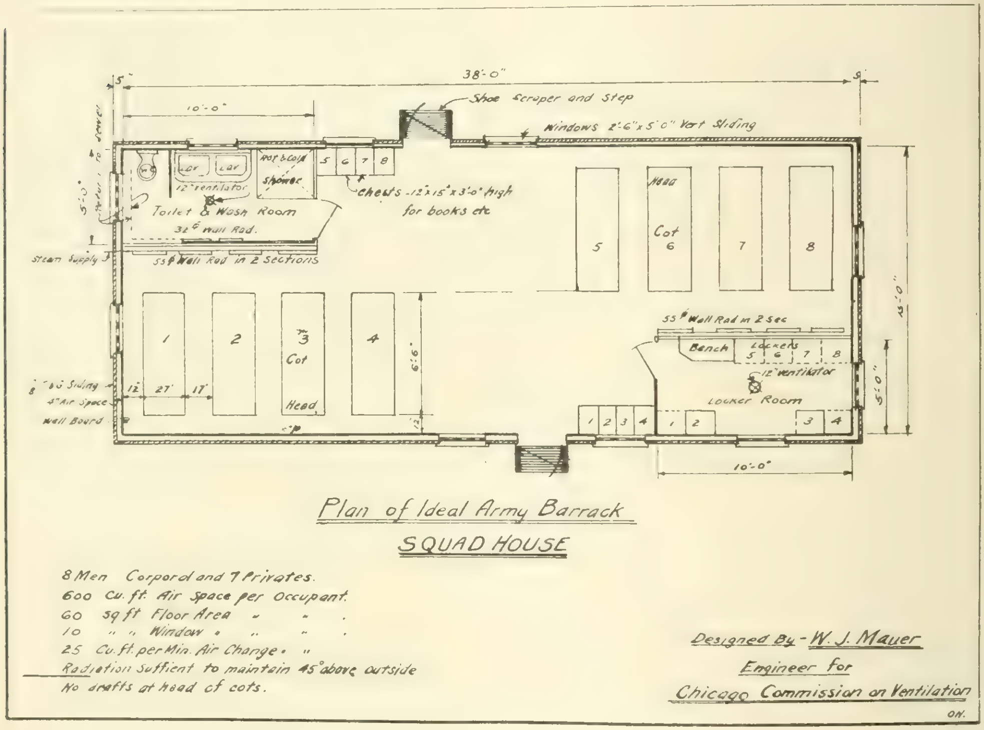
The arrangement of bunks is better than in the barracks previously described, in that they are further from the wall, but it is still a question in the minds of some whether double-deck bunks are as satisfactory as the single.

The dust count will probably be high because of the presence of lockers all through the center of the room. Men will come from out-of-doors and their clothing will be dirty or dusty and there will be a great temptation to brush the clothing or shake it on placing same in the lockers. It seems that both from a dust and bacterial standpoint it would be much better to have the lockers in a separate room by themselves, as for instance in the hall shown on the second floor.

The heating system was also changed from stove heat, as at first proposed, to steam heat. This is a very important change, the advantage of steam over stove heating having apparently been recognized.

In Dr. John S. Billings' report dated 1868 the following was read with a great deal of interest: "Dr. Craig's test for air conditions in a barracks is simple and practical," and it is described as follows: "Go into the room about 3:00 a. m. after 15 minutes walk in the fresh air. If no musty, unpleasant odor is perceived under such circumstances, the ventilation is probably satisfactory."

The barracks as described above will probably pass the test as outlined by Dr. Craig. This test, however, would prove no more than the taste of water would disclose the presence of typhoid bacilli.



PLAN OF PROPOSED SQUAD HOUSE.

SUGGESTED SPECIFICATIONS FOR ARMY BARRACKS.

Dr. Arthur Reynolds, former Health Commissioner of Chicago, gives some very valuable suggestions in his article on "Ideal Training Camps," which article appeared in the July, 1917, issue of *The Chicago Medical Recorder.* One suggestion is to limit the barracks to two men. There would be a lack of sociability among the men and for this reason and several other reasons it seems that a *Squad House,* caring for eight men (a corporal and seven privates) would be more desirable; this number, however, should be the maximum.

The *Squad House* shall contain eight bunks with a separate room for wardrobe at one end and toilets at the other. It should not be necessary for a man to leave the building for toilet or washing purposes. There shall be windows on all four sides of the squad house. A detailed drawing of the squad house as designed by the writer is shown herewith. It will be noted that with the arrangement of windows, radiators and cots no man will be subjected to drafts at his head. The allowance of window space, floor space and air space per occupant is that which is necessary for proper housing.

The *Temperature* shall vary from time

to time between 45° and 55° unless the outside temperature is below 10°, under which condition 40° above outside temperature shall be maintained.

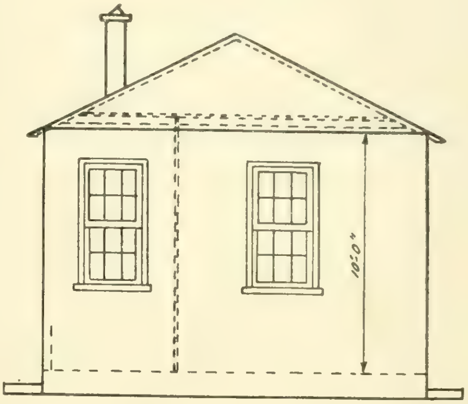
Heat shall be supplied from a central steam heating plant, with a proper amount of radiation in the squad house to furnish the above temperature and still allow the windows to be opened sufficiently to supply at least 25 cu. ft. of air per minute per occupant.

The following shall be a minimum allowance per occupant:

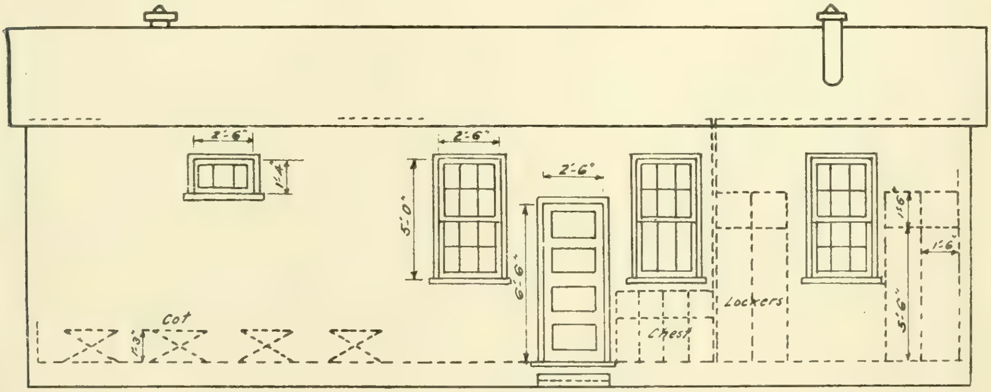
600 cu. ft. of *Air Space.*
60 sq. ft. of *Floor Area*
6 sq. ft. of *Window Area.*

Dust shall not rise to more than 5,000 particles per cubic foot.

Bacteria count shall not be over 4 on 3½-in. Petrie dish exposed two minutes.



END ELEVATION OF PROPOSED SQUAD HOUSE.



SIDE ELEVATION OF PROPOSED SQUAD HOUSE.

There shall be a 95% freedom from *Odors.*

The *Windows* shall be double-hung vertical sliding-sash type, capable of being opened both at top and bottom so that the air may be introduced at a high point and may be thoroughly diffused before coming into the breathing zone.

The windows shall be on all sides of the building to secure a uniform *Distribution* of fresh air throughout the room. The sill shall not be less than 3 ft. above the floor.

The *Cots* shall be uniformly distributed throughout the squad house and shall never be placed closer than 9 in. from any wall.

There shall be a separate room for the men's WARDROBE and a separate room for the TOILET, preferably at one end of the squad house, and care should be taken that the air supply to the sleeping quarters is not affected by these rooms.

All interiors shall be smooth finish and shall be *Painted* or *Limewashed* before occupancy and every three months thereafter.

Dust Pockets shall be avoided and care taken to keep the room free from dust and dirt.

The above scheme was worked out by the author and presented by him to the Chicago Commission on Ventilation at their regular meeting on July 24, 1917, and received its unqualified approval.

A Survey of Cloth-Window Ventilation

In the winter of 1912-13 the writer equipped one room in Sumner School, Syracuse, N. Y., with cloth-window ventilation, writes John B. Todd, in *School and Science*. Their use proved a surprising success in every way and finally the entire school was equipped. It was found that the school was ventilated much better than under the fan system. The saving of the power bill for the year was $320.00 and they burned 25 tons less coal. It was thought at first that more coal would be required as the air was so much fresher and free from odors, but raising the lower sash for the screen converts the upper half into a storm window and prevents heat loss; besides, all the heat loss in the ducts and apparatus is saved.

From this experiment in one room of forty-five pupils in 1912-13 Syracuse has (1915-1916) twenty-one schools equipped. The registration of these schools is 11,877 pupils.

Among these schools are every variety of heating apparatus—old buildings with half a dozen hot-air furnaces, to modern buildings heated by steam. The coal consumption of their twenty-one schools for five years under the old forms of ventilation was taken, together with mean temperature and wind velocity during the cold months of the year, and this was compared with coal consumption, mean temperature and wind velocity of the same schools for the same months of 1915-16 when they used cloth-window ventilation. Notwithstanding that the winter was exceptionally severe, in both low mean temperature and increased winds, there was a very substantial saving of coal, which, by very conservative estimates, amounted to 185 tons.*

There was also a very substantial saving of fan power as compared with the average cost for five previous years. Only seven of the schools have fans, and only one of the seven was completely equipped with screens, so that the fans were run more or less in six schools. But the saving in electric power bills for running the fan averaged $1.61 per screened window in the entire seven, and in the one school that was so well equipped with screens that they did not run the fan, the saving was $3.93 per screened window, so that the screens in this school paid for themselves the first year and also returned 100% profit on the investment.

The humidity of these rooms is nearly that of the outdoor air while its dust is 33% less.

In Sumner School, which has eighty-two screened windows and did not use the fan, the coal showed a saving of 25 tons for the year 1914-15. The school became popular as a fresh-air school and was so overcrowded that classes had to be established in the auditorium. To heat this required 20 or 25 tons, but even then the total consumed was ten tons less than used in 1912 and 1913 and the saving for the year was 30 or 35 tons.

Greeley, Colo., school board is using cloth-window ventilation in all of the grammar schools and in the high school. They have been using this form of ventilation three years and it has given such satisfaction that each year additional rooms are equipped. Dr. J. H. Miller, the medical superintendent, states that the attendance and health have been exceptionally high.

Rochester, Minn., has one school equipped. Superintendent H. A. Johnson writes that the teachers "are much pleased with this manner of ventilation."

Wellesley, Mass., Chas. A. Sibley, chairman school committee, writes that they have cloth screens in two schools and are planning to extend their use.

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* This work was done by Professor M. R. Sanford, of the U. S. Weather Bureau at Syracuse University.

Solvay, N. Y., has its schools ventilated with cloth screens. Superintendent Philip W. L. Cox states that they were made by the boys under the direction of the shop superintendent at the Solvay High School.

Oneida, N. Y., has every room in every school equipped with cloth screens. The superintendent of schools writes that "they save all drafts on the pupils and provide a very satisfactory ventilation."

Middletown, Conn.; For two years they have used cloth-window ventilation. Miss Brazos, of the Mount Vernon School, writes that they have been in use in all kinds of weather and are very much liked. She notes the freedom from infectious diseases and the comfortable air conditions.

Vicksburg, Miss.: Dr. E. F. Howard writes that the use of cloth screens has enabled the school windows to be kept open all winter, also that he has five bedrooms screened—the result is "complete success and satisfaction."

Plymouth, Mass., schools have started in the use of cloth-window ventilation.

Ithaca, N. Y.: Cloth-window ventilation is being used in the Home Economic Building, College of Agriculture.

Auburn, N. Y., is getting cloth-window ventilation, and reports it to be of considerable value in securing a larger supply of fresh air than was otherwise possible.

In Oakland and San Diego, Calif., cloth-screen open-window ventilation is used successively in cold weather.

New York City, School 51 Bronx: Hugh J. Smaller, principal, writes: "In reply to your inquiry concerning the use of cloth screens in the windows of this school, would state that here it was a dismal failure. The teacher went home ill several days, suffering from headache, and the general effect on the class was very unsatisfactory." In a postscript he adds: "The screens were only in use in one room and had to be removed for the health of the children." When asked for particulars I received a note from the teacher of the room addressed to "to whom it may concern" when referring to "wind deflectors" tried in her room, stating that they shut out too much light and that the air became offensive, causing headaches, dullness and listleness. One can hardly tell whether they ever used cloth-window ventilation or not, for while the principal speaks of cloth screens, the teacher refers to wind deflectors. It is evident that they did not have 1 sq. ft. of cloth screen per pupil, for a room so ventilated is never offensive; on the contrary the air is always sweet and wholesome. As to the lighting, in a room that has an adequate window space the lighting is improved by the diffused light of the screens.

In striking contrast with the "dismal failure" at 51 Bronx is the report from Stockton School, South Orange, N. J., where they have two rooms with six windows each. The teacher states that the work has been a success. That she had honor attendance during the severest weather, when older children in ordinarily ventilated rooms were out. There was complete absence of colds and grippe or communicable disease and only a single case of sore throat.

Practically all the pupils have gained. One girl weighing 52 lbs. at the beginning of the term, weighed 75 lbs. in the spring. The teacher states: "The only things which have caused friction have been educating the parents to the proper clothing and feeding of the children and the attributing of minor upsets to the *open-air* room. In these respects I have been a real pioneer, but have succeeded. Personally I feel that I am in better health than I have been in eight years. Previously I have lost my voice once or twice each year by laryngitis, but I haven't had a single attack this year. I weigh more than I did a year ago. I have had only one cold and that, strange to say, was during vacation." She states that in the work the children are alert and that the rooms have attained a standard of "excellent."

There are teachers who have spent years in dusty, ill-smelling rooms and have become so accustomed to it that they can not think of an open-air window, but even those teachers will finally get the fresh-air idea if they can have an opportunity to visit fresh-air rooms and observe the benefit derived.

CONSTRUCTION OF CLOTH SCREENS.

The really satisfactory screen has a substantial wood frame that fits closely into the window frame, so that there are no openings or cracks to let in cold drafts, and covered with Piquot or Black Rock unbleached cotton cloth. There are screen builders in every city who can make them correctly from the drawing. In many schools the pupils make and install them in the buildings. This is a valuable, practical demonstration of applied hygiene and will be reflected in their homes.

There are a number of "ready-made" cheap screens on the market which are of some value in sleeping rooms, but as the cloth is too flimsy for cold weather and the window can not be raised or lowered when they are in use, they are not as satisfactory as one could wish. One firm in Detroit manufactured and sold 300,000 of the low-priced screens last year, which as an index of the fresh-air idea is very gratifying.

CONCLUSIONS.

Following are some of the conclusions reached by Mr. Todd:

Cloth-screened windows one square foot per pupil furnish an abundance of pure air in cold weather.

There is one-third less dust in the room. The humidity is about that of the outdoor air.

Schools with cloth-window ventilation show a remarkable absence of infectious colds and sore throat.

The children are more alert and do better work, discipline is improved.

They can be used with advantage in any school but are of most value in buildings having steam radiation under the windows.

Cloth-window ventilation is merely the open-window method of ventilation in cold weather when the open window would be uncomfortable.

It is ventilation by diffusion of the air through the cloth. The incoming air is broken into currents of infinitesimal size and low velocity with no drafts.

The grade of unbleached cotton cloth branded Piquot or Black Rock is the right quality.

In a longer or shorter period cloth air screens become filled with dust and should be replaced with new cloth. The expense is slight. The old cloth can be washed and when lightly saturated with paraffine or machine oil makes valuable dustless dusters.

Next to a screened sleeping porch, cloth-window sleeping rooms give the greatest satisfaction. One has much greater resistance to infectious colds and lung diseases; besides one's nutrition and energy is increased.

Instead of larger and more expensive schools we should build one-story cottage or at least small one-story schools, and eliminate all mechanical apparatus by designing them for cloth screens. This would be economy and hygienic and educational efficiency. In the large schools we are putting too many eggs into one basket.

The load of a school is the risk—fire, panic and all infectious diseases. In a large school this risk is at maximum, in the cottage or small one-story school at the minimum.

One-Pipe Gravity Steam Heating Systems

Higher Costs Cause Revival of Its Popularity—Essential Points of Design.

By HAROLD L. ALT.

The continued rise in cost of both labor and materials is the direct cause of an increasing interest in the one-pipe steam heating system. There is no doubt that the one-pipe system is the cheapest to install of all heating schemes ever devised, with the exception of stoves, fire-places and warm-air furnace systems, which will be considered as obsolete in the present discussion, due to their lack of economy in fuel consumption.

As is well known, the one-pipe system may be installed in several different ways and involves the use of only one control valve and one pipe connection to each radiator; of course, automatic air valves are used for relieving air the same as on the ordinary two-pipe system. As far as labor is concerned, the increase of one pipe size in the steam supply does not produce an appreciable difference in work of installation and the added cost of the pipe is small; in exchange for this all return valves, return risers and (to a greater or less extent) all return mains in the basement can be omitted, resulting in a considerable economy over the cost of a two-pipe job.

While not the most satisfactory method in operation, the *true* and *complete* one-pipe system throughout involves the use of a single steam main of enlarged size to accommodate the condensation in the bottom of the main, instead of a separate return pipe; the idea also assumes that the condensation will flow in a direction opposite to the flow of the steam which is, of course, not ideal. As a general rule, the smaller the quantity of water so flowing, the less will be the trouble resulting therefrom.

TRUE ONE-PIPE SYSTEM AND MODIFICATIONS.

With the true one-pipe system *throughout* the steam main, risers and branches all pitch back to a point near the boiler where the condensation is al-

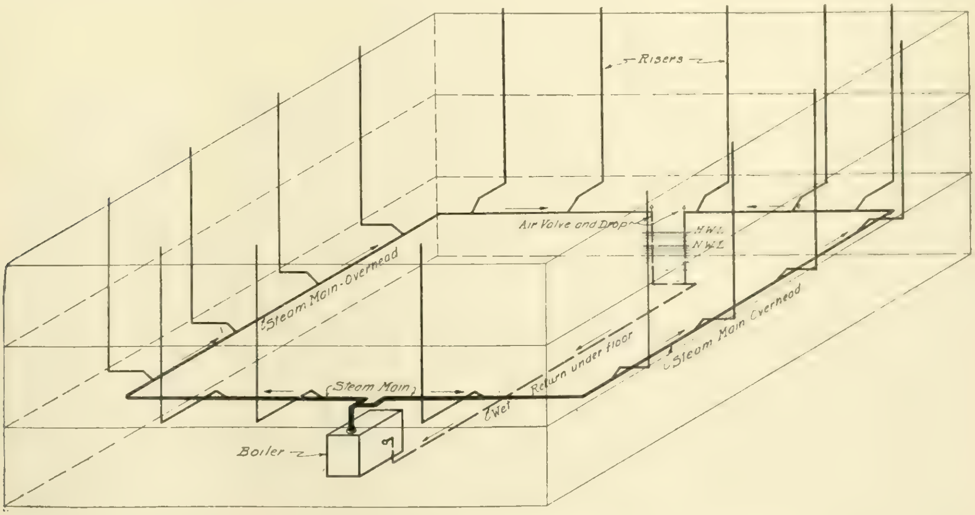


FIG. 1.—THE "CIRCUIT MAIN" ONE-PIPE SYSTEM.

lowed to separate itself and to drop down under the water line, returning to the boiler through the regular return connection. Such a system is seldom used, except for small residences, owing to the large quantities of condensation bucking against the flow of steam in the mains, and the slight modifications necessary to eliminate this are almost invariably adopted for any work of importance.

To obviate this difficulty what is known as the "circuit main" system has been used with great success. In this scheme, as shown in Fig. 1, the radiator runouts, risers and branches are left pitching down from the radiators and against the steam flow, but the steam main—the point of greatest trouble—is pitched *with* the flow of the steam so that the condensation flows along *with* the steam, instead of against it. At the end of the steam main run a drip pipe, or "bleeder," as it is commonly called, is dropped down below the water line and carried back as a wet return. In Fig. 1 and other drawings the pipes are pitched *down* in the direction indicated by the arrows and it is hardly necessary to say that all pockets should be avoided by the use of eccentric fittings or flanges while expansion must be properly cared for both on the steam and return main and in the radiator connections to the risers. This article is intended to cover the particular features relating to one-pipe design, rather than to discuss the elementary features of installation which apply to all steam systems, regardless of their type.

It will be noted that with the exception of the runouts and riser branches all of the condensation flows with the steam and as long as the risers do not get too big—*i.e.,* have too much radiation placed on them so as to produce an excessive quantity of condensation flowing back down—there is no difficulty experienced with this piping arrangement. For larger jobs, where the area is considerable, but the height of the building low, a system termed the "one-pipe relief" system is used. This is illustrated in Fig. 2 and consists of a steam main run around the basement ceiling similar to the main shown in Fig. 1 and pitched *with* the flow of steam. Every riser in this scheme is dripped at the bottom and is supplied by a runout taken from the bottom of the steam main so as to drip the main at every riser connection. Thus the steam main does not carry any con-

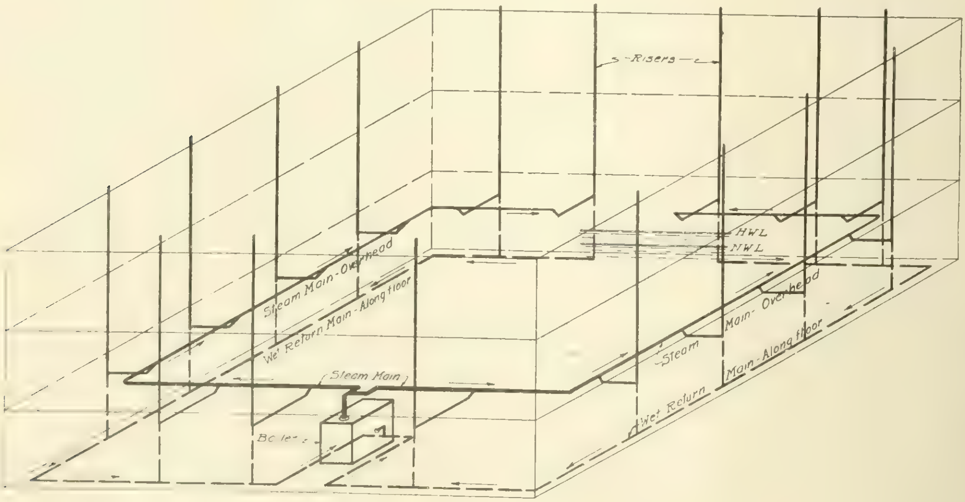


FIG. 2.—"ONE PIPE RELIEF" SYSTEM.

densation from the radiators and has its own condensation dripped at frequent intervals.

The return mains for the "one-pipe relief" system are usually run along the walls near the floor and as nearly under the risers as practical. The return should be a *wet* return, but if a dry return is absolutely necessary the drips should all be water-sealed before connecting thereto.

For jobs where the quantity of radiation goes up to, say, over 600 sq. ft. per riser, it is better to use the overhead or "Mills" system. This system and the "one-pipe relief" system more nearly approach a two-pipe job, having both steam main and a return main, but can be made in the one-pipe variety by using one radiator connection, with a single valve. A diagram of the well-known Mills system is shown in Fig. 3 and it will be noted that all the steam is carried up one main riser to overhead mains run around the top of the building and pitched down from the main riser to the various drops. The drops have tees at the required points of radiator supply and the condensation from the main at the top, from the riser itself and from the radiators connected thereto, falls down through the drops—flowing *with* the steam all the way—and is finally drained off through drips connected to the bottom of the drops and going to the main return—preferably a wet return—through which they find their way back to the boiler.

The Mills system, as can readily be seen, establishes more ideal conditions and should be used for higher building jobs, since the only portion of the piping in which the condensation is flowing against the return is in the radiator branches between the drops and the radiators. On the other hand, the Mills is a more expensive system to install than either the "one-pipe circuit" or the "one-pipe relief," but in spite of this should be used for all larger work where the other two systems would be liable not to give satisfaction.

TYPICAL DETAILS OF PIPING.

Having the general idea of the three schemes in mind, a few typical details will go far to assist in making a perfectly-operating plant. A system which is theoretically correct, but wrong in small details, never gives satisfactory service any more than a system rightly installed in the details, but theoretically wrong in the general idea.

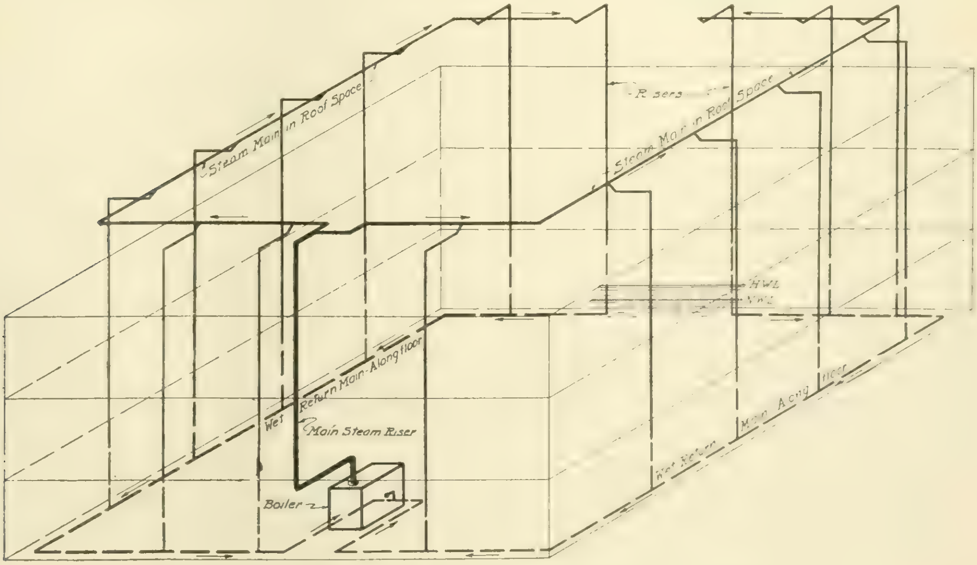


FIG. 3.—THE "MILLS" ONE-PIPE HEATING SYSTEM.

In all one-pipe work the steam connection to the radiator is practically alike; the connections must be made at the bottom and must be controlled (as shown in Figs. 4 and 5) by a gate valve or angle globe valve looking down, both of these points being determined by the necessity of accommodating the flow of the condensation out of the radiator. The automatic air valve should be placed on the opposite end of the radiator from the steam valve and about one-third to two-thirds of the height of the radiators above the bottom. The runouts, of course, must be arranged to provide for expansion in the riser.

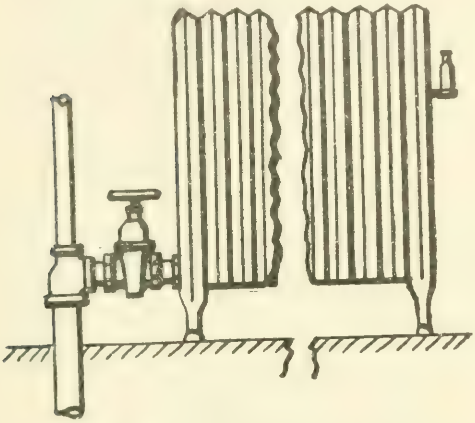


FIG. 4.—STEAM CONNECTION TO RADIATOR FOR ONE-PIPE SYSTEM, USING GATE VALVE.

For the "circuit" system (see Fig. 1) where the steam main drops down under the water line, an automatic air valve should be placed to relieve the air caught between the advancing steam and the water seal, when starting up the system. Otherwise, the air so pocketed will interfere with the return of the condensation and cause all sorts of hammering and trouble. Best results are obtained when the air valve is installed as shown in the detail, Fig. 6. In the "relief" and mills systems, no such air valves are necessary but are sometimes used at the end of the large steam mains merely as an aid to help relieve the air more quickly when starting up.

The steam runouts from the steam mains to the risers or radiators in a "circuit" system should be inclined down from the radiator or riser to the main and should enter the main at 45°, as shown in the detail drawing, Fig. 7, thus allowing the return condensation to flow along the bottom of the runout and down into the steam main without cutting across the path of the steam flow in the main. If the connection is made as shown in Fig. 8, the pouring into the steam main of the returning condensation is likely to interfere with the flow of steam therein.

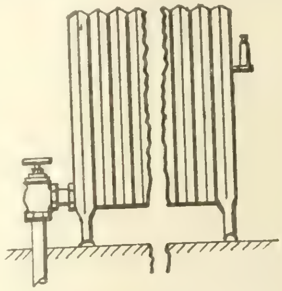


FIG. 5.—RADIATOR CONNECTION WITH ONE-PIPE SYSTEM, USING ANGLE GLOBE VALVE.

The runouts for a "relief" system should be inclined in the opposite direction toward the drip connection at the base of the riser, as shown in the detail, Fig. 9. It is practical to have these leave the main vertically downward but the 45° connection is more popular. The runout from a steam main in the Mills system is generally arranged as shown in detail Fig. 10, and slopes towards the steam drops.

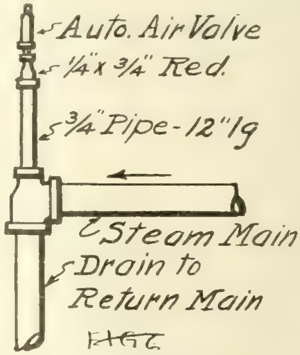


FIG. 6.—BEST LOCATION FOR AIR VALVE IN ONE-PIPE SYSTEM.

SIZING OF PIPES.

Having the general scheme of piping and the proper details for connections the next point is to determine on the proper size of pipe. It is easy to see that a riser feeding steam up against the down-coming condensation, in order to avoid excessive velocity, must be larger than a riser on the Mills system, where no such opposing movement exists. Also, that a main carrying condensation and steam—such as the steam main in the "circuit" system—must be made larger than one supplying steam only. As is well known, steam at atmospheric pressure, when condensed into water, occupies only a very small proportion of its original volume; in fact, it is roughly correct to say that a cubic foot of steam gives a cubic inch of water when condensed, or its liquid volume is about 1/1728 of its volume as a gas.

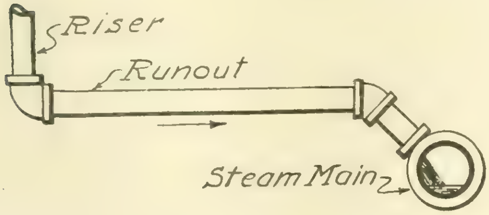


FIG. 7.—CORRECT METHOD OF MAKING RUNOUT FROM STEAM MAINS TO RISERS OR RADIATORS.

If the steam is assumed as flowing at a rate, say, of 2,000 ft. per minute and the return at a rate, say, of 100 ft. per minute, and 2,000 cu. ft. of steam per minute is being handled, then the area of pipe *for the steam* will be 2000/2000, or 1 sq. ft. The steam when condensed will occupy roughly 2000/1728 = 1.15 cu. ft.

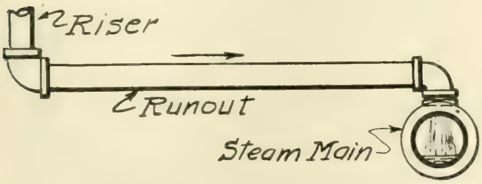


FIG. 8.—WRONG METHOD OF MAKING RUNOUT CONNECTION.

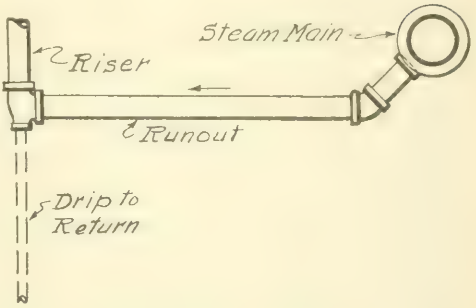


FIG. 9.—RUNOUT FOR A "RELIEF" SYSTEM

1.15 cu. ft. at 100 ft. velocity per minute equals 1.15/100 = 0.01 sq. ft. of pipe area.

Therefore, the actual increase required in the size of steam main is next to nothing, but in the "circuit" system it is customary to run the main either full size to the end drop or nearly full size, reducing at the most not over two pipe sizes.

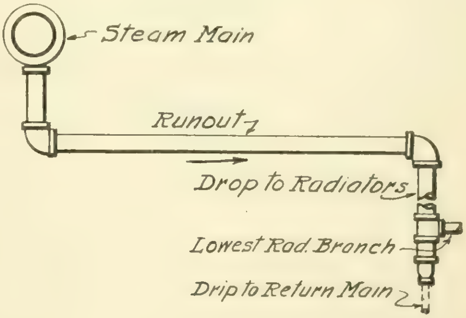


FIG. 10.—RUNOUT FROM STEAM MAIN IN "MILLS" SYSTEM.

With the "relief" system and also with the Mills, owing to the condensation not being carried in the steam main, no consideration need be given at this point. In all cases where the flow of condensation is against that of the steam—such as in radiator branches and riser runouts—the pipe is made one size larger than the steam supply which would be used for a common two-pipe system.

Therefore, in order to size a one-pipe job it is necessary to base the sizes on those which would be used for a two-pipe system; the determining factor in all steam pipe sizing is the allowable drop in steam pressure in which the job permits. For example, a system in which the drop in pressure can be made 5 lbs. will utilize smaller pipe sizes and will be more economical to install than the same system designed for a 2-lb. drop owing to the fact that the lower drop requires larger size pipe to reduce the pipe friction to the extent required.

Fig. 11 illustrates a diagrammatic elevation of a one-pipe system, assuming a 1-lb. drop in the steam line between the boiler and the end of the line in times of maximum load. Thus, with 5 lbs. at the boiler and 1 lb. loss in the line, the steam pressure at the far end of the line would be 4 lbs. The water in the wet return then has a pressure of 5 lbs. per square inch pressing down on its surface in the boiler and a pressure of only 4 lbs. per square inch pressing down on its surface in the vertical leg connecting with the steam main at the end of the run. This unbalanced pressure must equalize itself and does so by the water rising in the vertical leg until the *vertical column of water* in the leg *counterbalances* by its weight *the difference* between the two pressures; *i.e.,* the pressure loss in the steam pipe.

In Fig. 11 this loss is assumed arbitrarily as 1 lb. and since the weight of a vertical column of water is 0.43 lbs. per square inch for every foot of height, the rise of the water, under the assumed conditions, will be 1 lb. ÷ 0.43, or 2.33 ft. As a general thing, it is customary to allow less pressure drop and to keep 18 or 24 in. between the normal water-line and the high water-line established when the system is in operation. In other words, the lowest point of the steam and the radiation is kept at least 24 to 30 in. above the water-line of the boiler. In Figs. 1, 2 and 3 the normal water-line (N.W.L.) and the high water-line (H.W.L.) is indicated at the point on the return connections farthest from the boiler.

The high water-line should always be calculated to keep at least 6 in. below the steam main or lowest level of radiation, so that, with 30 in. difference, the water rise could not be over 24 in., with 24 in. difference the rise could not be over 18 in., etc. If 1 lb. = 2.3-ft. rise, then 16 oz. = 2.3 × 12, or 28 in. and 1 oz. = 1.7-in. rise. This results in a table for allowable rises as follows:

TABLE I.

Allowable Rise of Water in Return Mains, Inches.	Allowable Loss in Pressure in Steam Mains, Pounds.
3.5	1/8
7	1/4
14	1/2
28	1
42	1 1/2
56	2
70	2 1/2
84	3

When the total allowable loss has been determined, the loss per 100 ft. of run

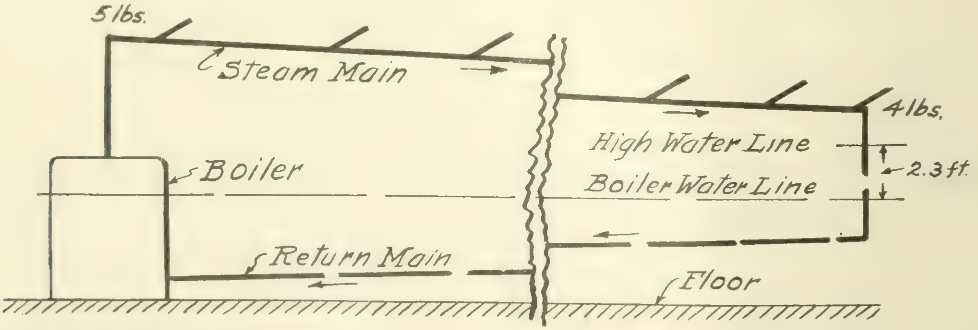


FIG. 11.—ILLUSTRATION OF PRESSURE LOSS IN ONE-PIPE SYSTEM.

must be calculated and the size of main based on tables computed on such losses. For instance, if the allowable rise of return level is 16 in., then, from Table I, 28 in. = 1 lb. drop; and if the total length of run of the main from the boiler to the farthest connection to the return main, plus 25% for fittings, valves, etc., should equal 200 ft. (approx.) then the drop per 100 ft. must be

$$1 \text{ lb.} \div \frac{200}{100} = \tfrac{1}{3} \text{ lb. per 100 ft., or}$$

equivalent.

Table II shows the number of square feet of radiation which can be fed by a steam pipe of given size with varying drops in pressure:

TABLE II.

Size of Pipe, In. Diam.	Drop in Pressure—Pounds per Square Inch.			
	1/8	1/4	1/2	1
	Square Feet of Direct Radiation.			
1	60	80	130	175
1¼	110	160	225	325
1½	200	280	400	550
2	465	640	900	1,275
2½	840	1,200	1,700	2,400
3	1,400	1,900	2,800	4,000
4	3,100	4,400	6,200	8,800
5	5,730	8,000	11,400	16,000
6	9,200	13,000	18,000	26,000
8	20,000	28,000	40,000	57,000
10	36,000	51,000	72,000	103,000
12	58,000	80,000	117,000	165,000

TABLE III.

Size of Steam Pipe, Diam. Inches.	Dry Return Diam. Inches.	Wet Return, Diam. Inches.
1	1	¾
1¼	1	1
1½	1¼	1
2	1½	1¼
2½	2	1½
3	2½	2
4	3	2½
5	3	2½
6	4	3
8	4	3
10	5	4
12	6	5

Table II has an allowance already included of 25% for loss in mains, so that it reads in E.D.R. (equivalent direct radiation) and no further allowance need be made. Thus, 460 sq. ft. of radiation on the equivalent of a 100-ft. run, with 1 lb. drop, would require a 1½-in. pipe, but, with a ⅛-lb. drop, would require a 2-in. pipe. All indirect radiators and other surfaces not equivalent to a radiation of 250 B.T.U. per square foot per hour should be reduced to such equivalent direct radiation (E.D.R.) and sized on the basis of E.D.R. Thus, an indirect radiator heating 1,000 cu, ft. of air per minute from 0° to 70° F., would give off B.T.U. as follows:

$$\frac{1{,}000 \times 60 \times (70^\circ - 0^\circ)}{55} = 76{,}000$$

B.T.U., roughly.

76,000/250 = 304 E.D.R., and at ½ lb. drop, would require 1½-in. pipe.

On all horizontal branches where the condensation flows against the steam, ⅛-lb. loss should be used, plus one pipe size.

Dry returns on small sizes are usually made one size less than the steam pipe supplying the same radiation and, on large pipe, two or three sizes less, while wet returns are usually made one-half the diameter of the steam pipe, or one-half, minus one pipe size; Table III may be used for consistent relations between steam and return mains.

Oftentimes it is found that the returns are so connected that it is much easier to size directly from the amount of E.D.R. that the return serves. In this case, Table IV may be used.

TABLE IV.

Nominal Size of Pipe, Diam. Inches.	Wet Return. Square Feet, E.D.R.	Dry Return. Square Feet, E.D.R.
¾	800	270
1	1,600	540
1¼	3,000	1,012
1½	6,000	2,024
2	12,000	4,050
2½	20,000	6,750
3	36,000	12,150
4	80,000	27,000
5	...	48,600

While it might seem that the returns are greatly overrated in Table IV, it is customary to increase the wet return sizes one or two pipe sizes to allow for the collection of sediment and blocking caused by corrosion. As a general rule, the wet return is not made less than one-third to two-fifths the diameter of the steam main.

To prove, however, that a wet return *will* carry the amount of water scheduled, it may be figured the same as a sewer pipe where the pressure is equal on both ends and the flow maintained by the pitch in the pipe. For instance, take the 4-in. wet return, rated at 80,000 sq. ft. of radiation; at ⅓ lb. condensation per square foot to allow for mains, the pounds of water per hour would be 80,000/3, or 27,000 lbs. roughly. 27,000/8⅓ = 3,000 gal. plus per hour, or 3,000/60 = 50 gal. per minute. With 9 in. pitch in 100 ft., a 4-in. sewer will discharge 81 gal. per minute, showing that if the water backed up in the return so as to produce 6 in. or 7 in. of head every 100 ft. of run, the 4-in. pipe *would* handle the 80,000 sq. ft. Of course, this 6 in. or 7 in. must be added to the rise in the return previously explained as due to the fall in steam pressure.

For risers with steam flowing against the return from the radiators, as occurs in the "circuit" system and "relief" system, a velocity in the main of 10 ft. per second should not be exceeded. On this basis Table V should be used for upfeed risers.

TABLE V.

Upfeed Risers.

(Velocity of steam, 10 ft. per second.)

Size of Pipe, Diam. Inches.	Sq. Ft. of Radiation, (E.D.R.)
1	30
1¼	60
1½	80
2	130
2½	190
3	290
4	520

With down-feed—such as occurs with the Mills system, an increased velocity of 50% or more is allowable, as shown in Table VI.

TABLE VI.

Down-Feed Drops.

(Velocity of Steam 15 ft. per second.)

Size of Pipe, Diam. Inches.	Sq. Ft. of Radiation, (E.D.R.)
1	50
1¼	90
1½	120
2	200
2½	290
3	340
4	800

Another authority sizes steam risers on a one-pipe system as shown in Table VII.

TABLE VII.

Nominal Size of Pipe. Diam. Inches.	Up-Feed Riser. 5 stories.	Up-Feed Riser. Over 5 stories.	Down-Feed Riser. 5 stories.	Down-Feed Riser. Over 5 stories.
	Square Feet of Radiation.			
1	34	30	60	54
1¼	67	60	112	100
1½	100	90	162	146
2	200	180	260	234
2½	367	330	600	540
3	667	600	880	790
4	1,333	1,200	1,600	1,440

This table, it will be noted, allows much greater loading of risers than Table VI, yet it has been used by one of the best engineering concerns in the country for many years and gives good and satisfactory service.

Radiator connections should be not less than the sizes shown in Table VIII.

TABLE VIII.

Size of Pipe, Diam. Inches.	Sq. Ft. of Radiation. (E.D.R.)
1	24 or less
1¼	24 to 60
1½	60 to 80
2	80 to 130

TABLE IX.

Fitting.	1-in.	1¼-in.	1½-in.	2-in.	3-in.	4-in.	5-in.	6-in.	8-in.	10-in.
	Lineal Feet of Additional Length to Be Added to Main									
90° Ell	3	4	5	7	10	13	17	20	27	33
Globe Valve	7	8	10	13	20	27	33	40	53	67
Entrance	5	6	8	10	15	20	25	30	40	50

TABLE X.

Radiation, Sq. Ft.	Main Size, Diam. Inches.	Runout and Riser, Diam. Inches.	Radiator Connections. Diam. Inches.
24	1	1¼	1
60	1¼	1½	1¼
125	1½	2	1½
250	2	2½	2
600	2½	3	..
800	3	4	..
1,600	4	5	..
2,300	5	..	..
4,100	6	..	..
9,600	8	..	..

All horizontal branches over 5 ft. long should be one pipe size larger than the riser to which they connect. This is due to the flow of condensation through the horizontal pipe being retarded.

While it has been previously stated in this article that 25% is allowed as added to the actual length of the main to obtain an equivalent length for the fittings, sometimes the friction may increase to 100% and when more accurate results are desired, the fittings, valves, etc., can be counted and the actual equivalent length computed. For this purpose the friction of each fitting and valve must be assumed as equivalent to an added length of run as shown in Table IX.

A method which can easily be memorized is to allow 60 pipe diameters for the "entrance," each globe valve and each tee, where the steam passes through the branch, and 40 pipe diameters for each 90 ell; tees passed through on the *run* and *gate valves* may be neglected. The "entrance" friction is the friction occurring when the steam enters the pipe.

For small residence systems Table X previously published in The Heating and Ventilating Magazine for April, 1908, will serve as a very complete schedule.

To summarize for each type of one-pipe system, the following tables and drawings should be used, as shown in Table XI.

TABLE XI

For Pipe Sizes of Various Portions of System.

Type of One-Pipe System.	For General Arrangement See	For Detail of Runout See	For Detail of Air Vent on Main See	For Detail of Radiator Connections, See	Supply See	Dry Return,	Wet Return, See	Risers, See	Radiator Connections, See
Circuit (common)	Fig. 1	Fig. 7	Fig. 6	Figs. 4 and 5	Table II	Tables III and IV	Tables III and IV	Tables V and VII	Table VIII
Circuit (residence)	Fig. 1	Fig. 7	Fig. 6	Figs. 4 and 5	Table X	....	....	Table X	Table X
Relief	Fig. 2	Fig. 9	None	Figs. 4 and 5	Table II	Tables III and IV	Tables III and IV	Tables V and VII	Table VIII
Mills	Fig. 3	Fig. 10	None	Figs. 4 and 5	Table II	Tables III and IV	Tables III and IV	Tables VI and VII	Table VIII

◆

Oil Burning Equipment for School Boilers.

E. P. Pratt, department mechanic for the Board of Education of Berkeley, Cal., has gathered some interesting statistics on the relative cost of heating school houses with oil and with coal, which are published in *The Architect and Engineer.*

During a period of five years Mr. Pratt kept a record of the cost of heating the Longfellow school building in Berkeley and found that the average cost per year was $167.80. More or less trouble was experienced continually in heating this building, and in the spring of 1915 Mr. Pratt asked permission to install an oil burner on trial. The board consented and a burner was installed and operated during the winter of 1915-16 at a cost of $70. The building was kept at a uniformly satisfactory temperature. There was no dust or ashes and a minimum of labor was required in keeping a proper head of steam. The amount given for heating the building was not really what the oil cost, and forty-five barrels of oil were placed in the tank on the last day of June so as to take advantage of a contract of 60 cents per barrel. Up to the end of January, 1917, the sum of $42 has been spent for additional oil to heat this building, and the amount of oil on hand will carry the building for the remainder of the winter. The cost for the two years will thus be $112 as against $327.60 for the two previous winters when coal was used. The cost of coal in Berkeley is $9.38 per ton.

Mr. Pratt has devised a simple method of checking the deliveries of oil to prevent shortages and overcharges. The oil tanks in the school house basement measure 5 ft. by 14 ft. and contain 2,050 gal. Each janitor has a measuring stick which shows just how many gallons are in the tanks. When a consignment of oil arrives the janitor measures the oil remaining in the tank, and when the delivery has been made he again takes a measurement. By deducting the first from the second amount he can quickly figure the actual amount of oil delivered. By comparing the drivers' delivery slip with his own checking he can readily tally the bill.

Standard Practice in Sprinkler-Heating Systems

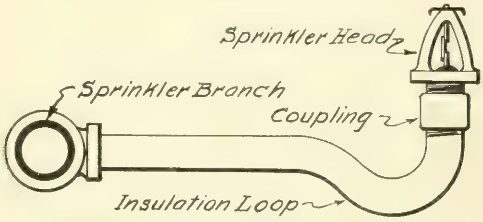
It has long been a common practice in certain sections of the country, notably in New England, to circulate hot water in sprinkler systems installed in factory and mercantile buildings, so that that they may be used for heating the buildings, as well as furnishing a protection against fire. A description of the latest practice in this line of work was presented at the last annual meeting of the National District Heating Association, by E. D. Densmore, an engineer, of Boston.

As is well known, the sprinkler system consists in general of a series of pipes which cover uniformly the ceilings of all floors. If the water which is maintained in the sprinkler system could be heated and circulated, of course this sprinkler piping could be used for heating. One fundamental objection would be that the sprinkler head which is in ordinary use would melt at the temperature necessary for the water if it were to be used for heating purposes. This melting of the sprinkler head is prevented by means of a U connection through which the hot water cannot circulate. It has been found in practice that such a device will prevent the head from melting. A sketch of this insulator or U connection is shown herewith.

In order to make sure that all the sprinkler piping will be an efficient heating surface, it is necessary to connect up the sprinkler mains and runouts so that circulation takes place through all the pipes, as shown in the accompanying diagram.

The connections of the hot water heating system with the sprinkler piping are exceedingly simple and need not change the sprinkler piping in any way. The hot water heater may be located in any convenient place, either in the building to be heated or in an adjoining building. From the hot water heater a hot water supply pipe is run and connected to the foot of the sprinkler riser inside the alarm valve. It is advisable to install a valve at this point, so that the hot water supply may be entirely shut off from the sprinklers when necessary. Between the hot water connection to the riser and the sprinkler heads no changes are made, the sprinkler riser, laterals and distributing pipes being installed in the usual way.

In practice it is found that when the conditions in a building are such that circulating the water in the sprinkler system will give adequate heat, the cost of the combined system is less than the cost of a separate sprinkler system and a separate heating system. If the sprinkler system does not give sufficient heat it is necessary to add radiators or coils. This complicates the scheme somewhat, but of course up to a certain point additional surface can be installed and still have the combination scheme cheaper.



DETAIL OF INSULATOR CONNECTION.

The general arrangement of the system is such that the water in the sprinkler system is circulated upward through the building and back through the heater. This circulation will take place by gravity when conditions are favorable or it can be forced by a pump. Whatever pressure is on the sprinkler system will of course be on the heating system.

It is necessary to arrange for the expansion of the water. If the building is on a tank this expansion could be taken care of through the tank. The ordinary sprinkler system has check valves on both the tank supply and on the street supply so that some special scheme for expansion is usually necessary. Sometimes a pressure expansion tank is installed or else by-pass connections are placed around the check valve. If cast-iron radiators are to be used, it is to be borne in mind that in high buildings the static pressure on the lower floors is considerable.

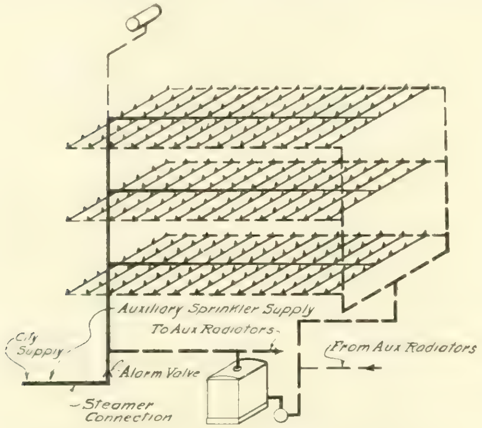


DIAGRAM OF PIPING FOR SPRINKLER-HEATING SYSTEM.

The advantages claimed for this combination system are simplicity and first cost. These claims would be justified where the sprinkler system would supply the larger part of the heat necessary. It is also claimed that the sprinkler pipes, having water circulating all the time, are less liable to become clogged up. It is also claimed that a uniform distribution of heat is obtained. This is true, but of course it is also true that the heating surface is all on the ceiling which in some cases would not be desirable, particularly where heat is required under windows to prevent drafts.

In general the objections to such a system are that it is undesirable to mix up the fire protection system with anything else. The inspection and maintenance of the fire protection system is of great importance and it is a grave question whether or not it is wise to combine this system with the heating system from the point of view of fire protection. The necessity of having the sprinkler heads connected with the U connections makes it possible for sediment to collect in these U connections since no circulation takes place through this pipe.

In general it may be said that this system offers an opportunity for a wide range of usefulness and it might be expected that as time goes on the field which it will occupy will broaden.

◆

Coal Heat Three Times Cheaper Than Electric in Seattle.

The cost of heating an average-sized house by electricity is about three and a half times as much as heating it by coal. Dr. Frederick A. Osborn, head of the physics department of the University of Washington, has reached this conclusion after experimenting with the two methods of heating in his own home, a seven-room dwelling.

Dr. Osborn has used a high grade of lump coal in a 0.24 Standard hot-air furnace for the past three years. The coal cost $7.75 per ton, delivered in the basement bin. The annual average cost of heating the house for this period of three years was $75.

All the rooms electrically warmed were equipped with the wire-resistance convector type of electric heater. The rate for electric heating was 1c. per kilowatt-hour.

From the tests, Dr. Osborn has determined that electricity selling at 0.29 cent per kilowatt-hour would furnish heat for the same cost as coal costing $7.75 a ton.

◆

Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

HIGH-PRESSURE STEAM

Heating and Ventilation at Harrison Tech. Ills. 2,500 w. Prac. Eng., Chi.—Aug. 15, 1917. Steam for heating Chicago Institution at high pressure. 20c.

CENTRAL STATION HEATING

Standard Tests for Condensation Meters.

A form of test has been devised by the Test Committee of the National District Heating Association, which, it is stated, will indicate the fundamental characteristics of any condensation meter now on the market. The method was described at the association's recent convention in Detroit. It is emphasized that the results sought in such tests are the *inherent* characteristics of the meters and should therefore be obtained under as nearly ideal conditions as possible. In other words, the meters so tested should be in perfect condition as regards dirt, lubrication, and adjustment, and no variation of these factors should be allowed to enter into the tests.

The following series of tests were selected as indicating the fundamental characteristics of any condensation meter:

TEMPERATURE-ACCURACY TESTS.

These tests have for their object the determination of the performance of the meter under varying temperatures of the condensation. A constant rate of flow, sufficient to operate the meter at about 80% of its rated capacity was used. The temperature of the water was measured at the meter inlet in the manner shown in Fig. 1. Tests were taken at temperatures ranging from 50° to 210° F. The water was weighed before entering the meter.

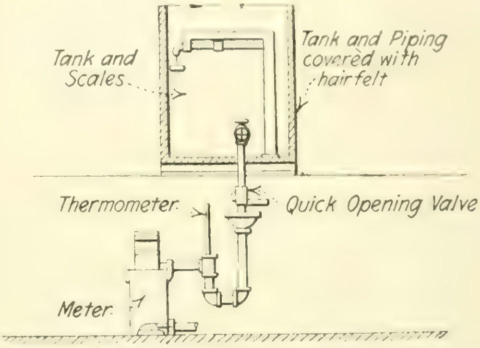


FIG. 1.—ARRANGEMENT OF APPARATUS FOR TESTING CONDENSATION METERS.

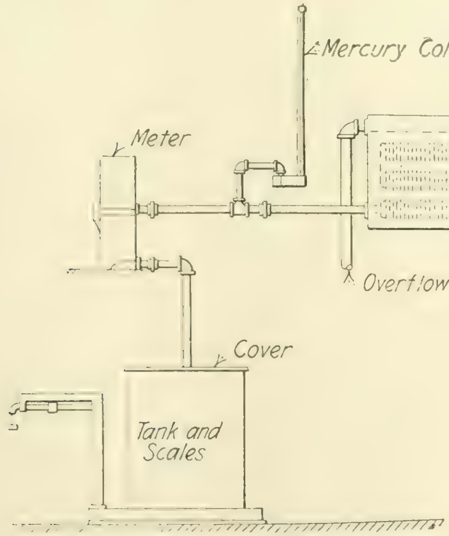


FIG. 2.—ARRANGEMENT FOR MAKING STEAM PRESSURE TESTS.

LOAD-ACCURACY TESTS.

In these tests the accuracy of the meters was determined under various loads ranging from a very small stream of water up to the maximum amount which the meters would handle with a water head of about 12 in. above the meter inlet. The temperature of the water was kept as near 185° F. as possible and was measured at the meter inlet. The water was weighed before entering the meter, as in Fig. 1.

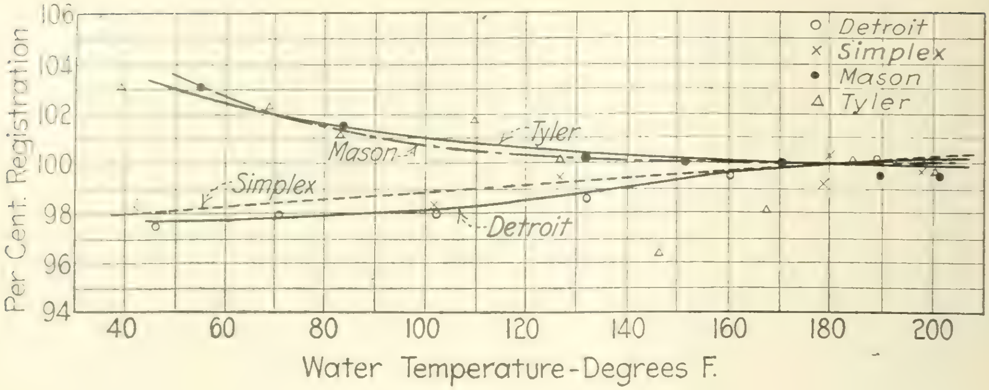


FIG. 3.—TEMPERATURE ACCURACY TESTS.

STEAM-PRESSURE ACCURACY TESTS.

In these tests the meters were operated under conditions similar to those set up by a "blowing" trap. A mixture of steam and water was delivered to the meter in the manner shown in Fig. 2. The pressure of the entering steam and water was measured with a mercury column at a point 6 in. from the meter inlet. A sufficient amount of condensation was used to operate the meter at about 25% of its rated capacity. Tests were made at increasing pressures until some occurrence, such as the stoppage of the meter, was noted.

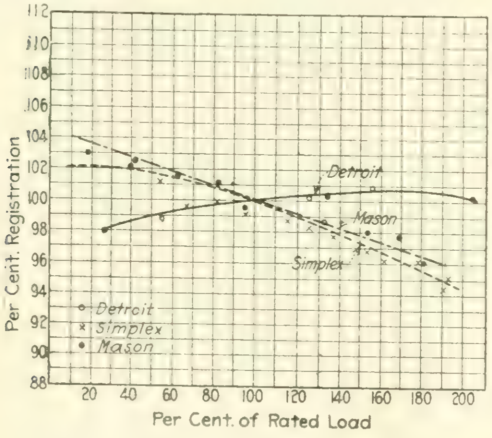


FIG. 4.—LOAD ACCURACY TESTS.
Water Temperature 185° F.

Similar tests were reported by the meter committee in 1914 on the Detroit and Simplex meters. The present committee has conducted tests on the Mason and Tyler meters and made some check tests on the other types. A complete report is given below.

The meters tested were as follows:

Meter	Made by	Size	Rated Capacity
Detroit	Central Station Steam Co.	C	675 lbs. per hour
Simplex	American District Steam Co.	4	750 lbs. per hour
Mason	Gilmore Mason	—	900 lbs. per hour
Tyler	Tyler Underground Heating System	2	800 lbs. per hour

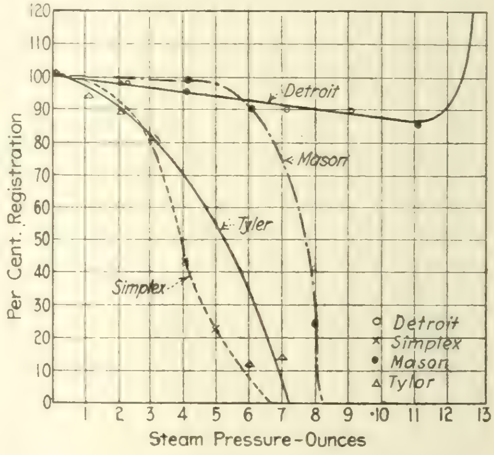


FIG. 5.—STEAM PRESSURE ACCURACY TESTS.
25% of Rated Load.

In ordinary tests, meter accuracy is usually expressed in "percentage of accuracy" which is taken as the weight of water registered, divided by the actual weight. In this case, all of the meters tested varied somewhat from 100% accuracy at rated load and in order to reduce the results to a comparative basis, the actual weight of water at rated load was used as a basis for computing the percentages, instead of the weight registered. By this method all of the curves intersect the 100%

mark at rated load, and the results are comparable.

In the temperature-accuracy tests the actual weight of water which passed through the meter in the standard number of revolutions at 185° was taken as 100% accuracy and this weight was used as a basis for computing the accuracy of the other tests. The temperature-accuracy curves, therefore, intersect the 100% line at 185°.

The temperature-accuracy tests are shown in Fig. 3 and the load-accuracy tests in Fig. 4. Fig. 5 shows the action of the meters under steam pressure. In these last tests it will be noted that the Detroit meter first under-registers and then begins to over-register greatly at about 12 oz. pressure. All of the other meters begin to under-register at a slight pressure and registration practically ceases at a pressure of about 8 oz.

While only one meter of each type was tested, the tests were made with great care.

◆

The Cost of Leaking Steam.

To determine the cost of leaking steam with any degree of accuracy we must know at least four factors: (1) the number of pounds of steam evaporated by 1 lb. of coal; the greater this is, the less is the cost of leaky pipes, other conditions being the same; (2) the total area of leakage; (3) the absolute steam pressure, which is equal to the gauge pressure, plus the atmospheric pressure; at sea level this is usually reckoned as gauge pressure, in pounds per square inch, plus 14.7; and (4) the cost of coal per ton of 2,000 lbs.

For example, how much money is lost every 10 hrs. under the following conditions: 9 lbs. of steam are generated by each pound of coal. The total area of leakage is ½ sq. in. The gauge pressure is 105 lbs. per square inch (making the absolute pressure very close to 105 + 14.7 = 120 lbs. per square inch). The cost of coal is $3.50 per ton.

Referring now to the chart, lay a straightedge across the chart three times as indicated by the dotted lines and the problem is solved. Run the first line from the 9 (column A) through the 120 (column C) and locate the intersection in column E. Run the second line from that point of intersection to the 0.5 (column B) and locate the intersection in column C. From that point of intersection run the third line to the $3.50 (column E) and the answer is found at the intersection with column D. The answer is $6.00 loss per 10 hrs.

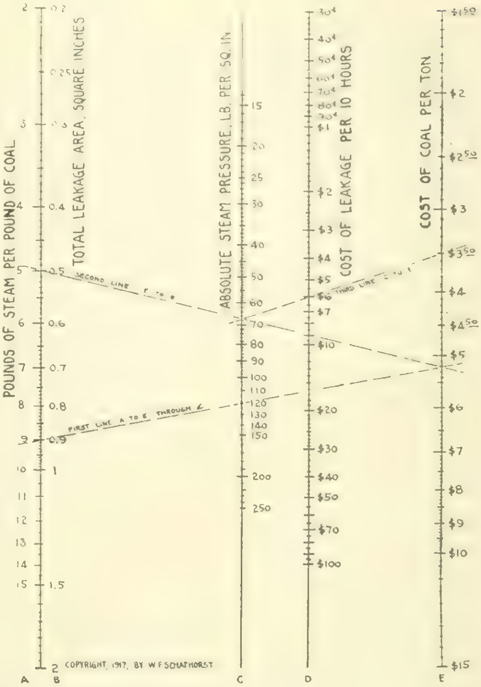


CHART FOR DETERMINING COST OF LEAKING STEAM.

In case it is found that the total leakage area is less than shown in column B, the chart may be used by shifting decimal points. For example, if, in the above problem, the leakage area had been 0.05, instead of 0.5 sq. in. the answer would be 60 cents, instead of $6.00, per 10-hr. day.

When using the chart, the steps must follow in the order shown and above described. First line, A to E through C. Second line, E to B. Third line, C to E.

The range of the chart is great enough to easily handle any ordinary problem.—*W. F. Schaphorst.*

◆

Finds a Coal Mine in His Cellar.

While digging a cellar for a new home in Norton, Wise County, Va., Henry M. Bandy's workmen came across a 4 ft. x 5 ft. vein of bituminous coal of high calorific value, states the *Ideal Heating Journal.* The house is on the side of a mountain, and Mr. Bandy calculates that he has something like 60,000 to 70,000 tons of high-grade soft coal on his property of 150 x 300 ft.

With a few strokes of the pick, the fuel is unearthed and fed to the boiler. A careful calculation indicates that Mr. Bandy is procuring his coal at an average price of 30 cents per ton.

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THE painful experiences through which many central station heating companies are going in trying to meet the rising cost of coal, labor and pretty much everything else that goes into the maintenance and operation of their plants, has again directed attention to the "municipal ownership idea," which has unquestionably gained ground during recent months. It must be admitted at the outset that, from the standpoint of efficient operation for extended periods, a municipal plant may not be expected to compete successfully with a privately-owned plant. In all previous arguments that has been one of the deciding factors. But now a new situation confronts the industry which, coupled with the growth of State commission regulation, has given pause to more than one utility company.

Briefly, the situation is that the companies are finding themselves without the necessary income to meet the big jump in costs. Almost all of them have petitioned the public service commissions for rate increases and it must be said that the petitions generally have been granted, but the great question is, is the relief adequate, and, if not, will it be possible to still further advance the rates in the near future, should such a step become necessary?

To these companies the municipal ownership idea is appealing with a new force, not because of the usual arguments in favor of it, but as a logical sequence of the combination of commission control and extraordinary costs.

It does not seem, however, that any constructive work is to be done in advocating the municipal ownership of central heating plants. If central heating plants can not be made to pay under private management, they certainly could not under municipal management. One might even go so far as to say that any institution of this kind which does not pay should not exist.

In other words, municipal ownership is not a cure-all for bad situations and it would be poor policy, as well as poor business, to ask tax-payers to protect ill-advised municipal undertakings. In the case of district heating operation, there is hardly enough fundamental economy at best in the industry to run the risk of having the proposition mismanaged by the average municipal authorities.

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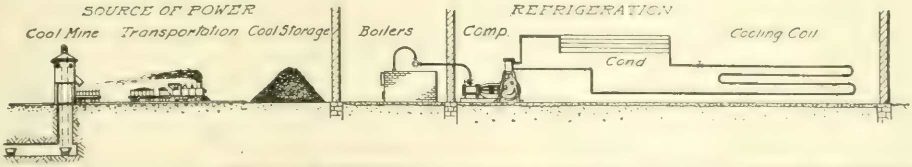
THE publication of the monthly weather charts for five representative American cities will be resumed in the next (December) issue. This will make the twelfth year of publication of these charts.

AIR COOLING AND REFRIGERATION



Carbonic Anhydride Refrigeration Plants

As has been stated, ammonia, while particularly suited to refrigeration uses, is not the only medium so employed. Successful plants and apparatus have been developed utilizing other gases among the most prominent of which are carbonic anhydride gas and compressed air.

REQUIREMENTS OF CARBONIC ANHYDRIDE PLANTS

Practical refrigeration machines employing carbonic anhydride gas are on the market, these being built and operated in a manner largely similar to the ammonia systems already described inasmuch as the gas is liquefied by the removal of its latent while under pressure in condensers; the operating pressure, however, differs materially.

In order to keep the gas in a liquid state the following pressures must be exerted, according to the temperatures in degrees Fahr.

Deg. F.	Required Pressures; Lbs. per Sq. In.
80	1000
30	500
0	311
—30	183
—80	96
—150	21
—180	0

Where the compressed gas of any refrigeration system is passed rapidly through a condenser it has been found that the temperature of the liquefied gas runs about 10° higher than the condensing water so that if the maximum water temperature is 60° to 75° F. the operating pressure on the gas must be close to 1000 lbs. per square inch. A chart

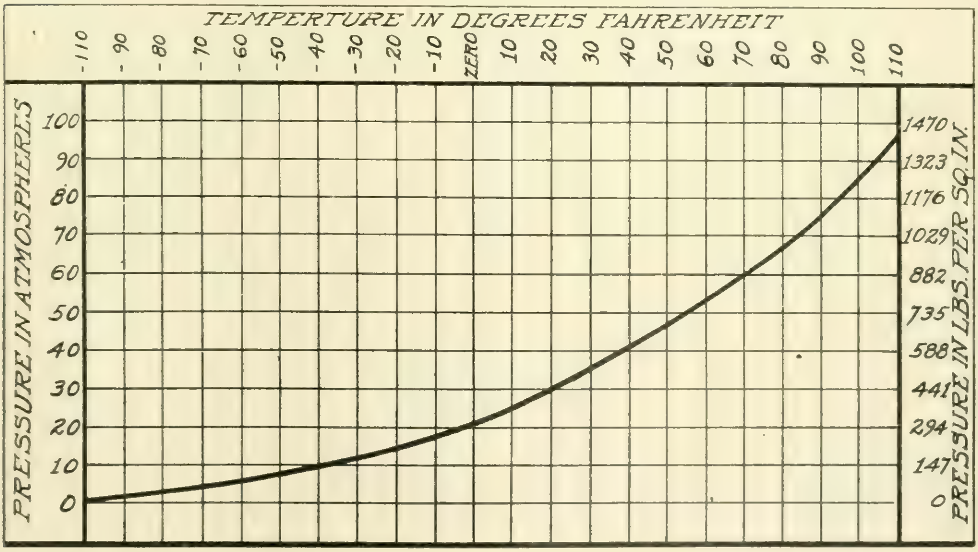


FIG. 1.—PRESSURES AND TEMPERATURES OF EVAPORATION.

covering the pressures and temperatures of vaporization is given in Fig. 1.

Not only must the machine be built very heavy to withstand such a pressure, and unusually heavy fittings used on the pipe, but, besides this, leaks are almost impossible to avoid and the diameter of the gas cylinder must be kept much smaller than the steam cylinder.

Leaks of carbonic anhydride gas are particularly dangerous as they are not noticeable by smell (as is the case with ammonia) and the gas being heavier than air sinks into cellars or other low spots, collecting at such points and rendering a person almost unconscious before its discovery is made. For this reason when this gas is used leaks are particularly dangerous and must be most carefully guarded against.

Compressors for carbonic anhydride gas are almost invariably of small size and made of the single-acting type, owing to the difficulty of keeping stuffing boxes tight under the high pressures necessary; compressors of larger size are constructed, however, for liquefying this gas for special beverages and for use in charging the familiar soda fountain. For such purposes it is liquefied and transported in steel carboys which are delivered to the various fountains. The compressors are generally compounded, the low pressure cylinders delivering the gas to a receiver at about 500 lbs. pressure; the gas is cooled in the receiver and is then compressed farther in the high-pressure cylinder up to a pressure of 1000 lbs.

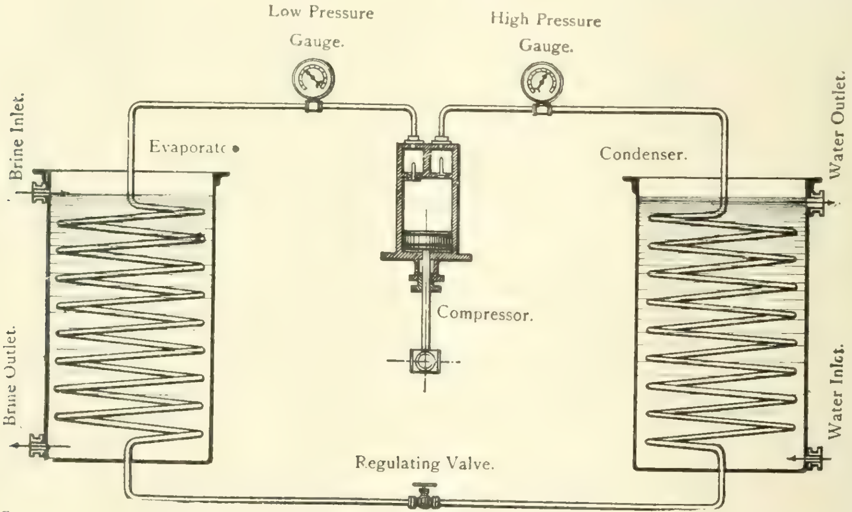


FIG. 2.—CYCLE OF OPERATION FOR A REFRIGERATION PLANT OPERATED WITH CARBON ANHYDRIDE GAS.

The cycle of operation for a refrigeration plant operated with this gas follows along lines similar to that of the ammonia compression plant; as indicated in Fig. 2, the gas after compression passes into an oil separator where it is freed from the oil from the compressor cylinder; from the cylinder the gas passes into the condenser where it is cooled and condensed, its latent heat being absorbed by the condensing water. The liquid then flows to a receiver and from there is carried to the cooling coil through an expansion valve which allows the pressure to drop to about 40 lbs.

It is possible to use the gas directly in the cooling coils or to use the coils to cool brine which in turn is circulated to the brine refrigeration coils, thus securing better temperature control in the coils by controlling the brine temperature.

Direct expansion coolers are also built for use with the system when it is desired to do air cooling, the cooler being placed in the air washer spray chamber. Such a cooler is shown in Fig. 3.

COMPARISON OF CARBONIC ANHYDRIDE AND AMMONIA PLANTS

According to the manufacturers of carbonic machines the following is a comparison of the advantages and disadvantages between carbonic anhydride and ammonia.

CARBONIC ANHYDRIDE

1. Is harmless and odorless.
2. Is a fire extinguisher; it does not unite with lubricants, cannot be disintegrated, and does not deteriorate.

3. Is neutral, does not attack metals nor food products, and is a preservative.
4. It is cheaper than ammonia.
5. The entire charge of CO_2 in a refrigerating plant could be discharged into the engine-room without any evil results whatsoever.
6. CO_2 is absolutely non-explosive and will not support combustion under any conditions, but on the contrary will retard it.
7. The actual horsepower required for CO_2 machines of capacities between 10 to 25 tons is 1.2 H. P. per ton for refrigeration with condensing water at 70° F. With larger capacities the economy in power requirements increases correspondingly.

   In this connection they refer to pratical tests made by themselves, by consulting engineers employed by them for this purpose, and by a commission of engineers appointed by the Danish Government. The results are as follows:

   No. 1—Twelve-ton plant at 1.2 H. P. per ton of refrigeration with water at 56° F. and brine at 6° F.

   No. 2—Fifty-ton plant at P. Barman Brewery, Kingston, N. Y., 1.01 H. P. per ton of refrigeration with water on condenser 53° F., off 81° F.
8. Carbonic acid machines are constructed very strong and compact without reaching the proportions of ammonia machines of the same capacity. A cylinder bore of 4⅛ in. in these machines corresponds to a bore of 9½ in. in an ammonia machine of same capacity.
9. The operation of CO_2 machines is very simple; for instance, if it is desired to inspect the inside of cylinder, it is only necessary to close the discharge and suction stop valves (both valves being mounted on the side of the cylinder) and open the machine where desired.
10. It is an acknowledged fact that the CO_2 refrigerating machine is the only one which may be installed anywhere with perfect safety. This is especially important for plants installed in hotels, stores, hospitals or any building where a number of people assemble. This also applies to ships of all kinds. This machine is provided with a safety valve which relieves the pressure, should it become excessive. The use of this valve is impossible with the NH_3 system on account of danger from the escaping gas. A substantial proof of the foregoing is the fact that with thousands of CO_2 machines in practical operation, there is not a record of a single accident in connection with same.
11. The CO_2 machine possesses the maximum economy of any compressor. One of the most important factors of this machine is the low ratio of compression which is but one to three, and consequently the re-expansion of the gas in the clearance space amounts to very little.

ANHYDROUS AMMONIA

1. Is a blood poison and possesses a very pungent, unbearable odor.
2. Is inflammable when mixed with oil. It disintegrates at a high temperature and becomes an explosive.
3. Ruins everything with which it comes in contact, either through its penetrating, suffocating odor, or its corrosive action which attacks all metals.
4. Costs more.
5. One-half per cent of ammonia in the atmosphere renders life unendurable.
6. Ammonia becomes a high explosive in case of fire, as it disintegrates at high temperature into its constituents, nitrogen and hydrogen, the latter being a combustible gas.
7. Requires 1.3 H. P. per ton of refrigeration with condensing water at 70° F. and machine capacities between ten and twenty-five tons is the best economy ordinarily reached with ammonia machines in practice. It is claimed that the theoretical efficiency of ammonia machines is greater than that of the carbonic acid machines when using condensing water of high temperature. This assertion, however, is not substantiated by practical experience. On the contrary, marine refrigerating engineers and plant owners in tropical climates who have both systems in operation, contend that the economy of the ammonia machines falls short of the economy of carbonic acid machines when using condensing water at 90° F. and above.
8. Ammonia machines of even capacities considerably exceed the carbonic acid machines in bulk; they have longer frames and require a compressor volume six times as large as the compressor volume of CO_2 machines.
9. Ammonia machines possess numerous by-pass connections and arrangements for evacuating the different parts of the system, which are controlled by a great many valves, etc., and before the machine can be opened for the inspection of stuffing-box, piston packing or the valves, it is absolutely necessary to discharge all the ammonia into the condenser, confining it there by closing all the valves leading from same to the part to be inspected.
10. Ammonia explosions occur frequently, and while it is doubtful from a strict

chemical point of view that such explosions can take place at the ordinary temperatures, the fact remains and the causes have been attributed to the presence of hydrocarbons, resulting from the decomposition of the lubricating oil.

Most of the ammonia accidents may have been caused purely by bursts, giving evidence of excess of pressure which may have been caused by water.

11 The efficiency of ammonia machines is very readily impaired by clearance space, leaky valves, etc., for the reason that the ratio of compression in the ammonia machine is high, being ordinarily one to ten and sometimes one to fifteen, and such clearance space will allow the re-expansion of the gas, and reduce the capacity of the machine.

Notes

It is claimed that electric wiring in conduits is not suitable for cold storage rooms or refrigerators owing to short-circuiting which is almost positive to occur within the compartment. It is recommended that all such wiring be made of waterproof wire, run exposed.

It has been agreed that clear artificial ice costs more than gray ice and, as the cooling effect is the same and the cost less, that clear ice is a useless and expensive requirement. Possibly this is true, yet we challenge any one to produce the effect of apparent purity and the appetitizing delight contained in a piece of clear sparkling ice.

Ice for purposes where it is used *visibly* will be *clear* for a long time to come and we believe that ice so opaque as to prevent seeing through a comparatively thin piece will never enjoy the popularity of the clear and transparent production.

Refrigeration enjoys a place in the sun and for the preservation and conserving of the food supply the cold storage warehouse is a most valuable adjunct—but as a means for the speculator to corner the market it is indeed abhorrent. There has been considerable agitation against the cold storage warehouses from time to time as evinced by the more or less frequent enactment of laws of increasing stringency relation to the length of time products may be held.

The far-sighted cold storage owners will not need to be reminded that the perversion of these plants for such purposes is not only pernicious but will not be endured under present conditions. Patriotic owners can assist the government and the country by personally preventing the use of their plants to aid such purposes.

A new helmet to protect the operators of ammonia plants when ammonia leaks cause dangerous fumes to form has been put on the market by the Protecto Safety Appliance Co., Newark, N. J. The helmet somewhat resembles the well-known smoke helmet and can be adjusted on the wearer in one-half minute. After entering a gas-filled room this helmet will protect the wearer for a period of two hours.

Kroeschell Bros. Ice Machine Co., of 472 West Erie St., Chicago, makes a specialty of carbonic anhydride plants for air cooling purposes, and also of small and compact refrigeration plants. Fig. 1 shows a self-contained refrigerating unit, the condenser and machine being mounted on a combined brine and ice tank.

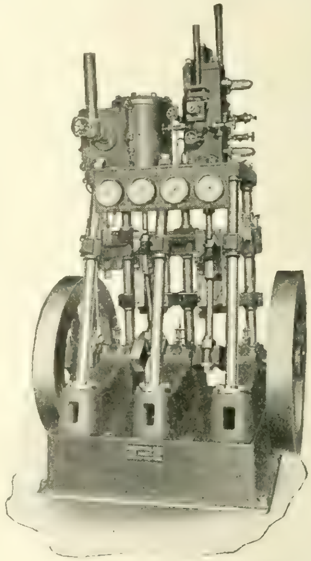
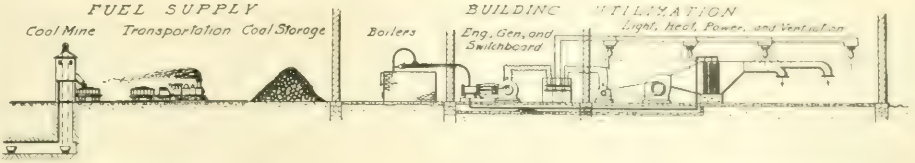


FIG. 1.—TYPE OF SELF-CONTAINED REFRIGERATING UNIT.

For refrigeration plants of small capacity the Remington Machine Co., Wilmington, Delaware, has specially suited machinery arranged for electric drive.

POWER PLANT ENGINEERING



Automatic Control For Boiler Feed Pumps

Having selected the boiler-feed pumps and determined their size, (see October issue) the piping and method of control should next be decided upon. The piping is separated into two distinct parts, these consisting of the connections for the steam end and the arrangement of suction and discharge piping on the water end.

The water connections depend a good deal on just what the pump is required to do besides strictly boiler-feed work. If used for feeding alone the common practice is to run two headers along back of the water cylinder —one being a suction header and the other a discharge header. From these headers branches are run to each pump, the suction branch being valved and usually provided with a strainer between the valve and the pump. The discharge branch is also valved, is usually provided with a check between the valve and the pump and should have a relief valve between the check and the pump.

Strainers, as the reader is aware, are for the purpose of preventing any obstructions entering the pump and getting into the valves or cylinder; they are manufactured in a variety of forms, some of the most common of which are illustrated in Fig. 1.

Relief valves should be of the hydraulic type and should be capable of taking the entire delivery of the pump, assuming that the discharge valve has accidently been left closed when the pump is started.

If the pump is to serve as an emergency pump for other lines, or if other pumps are to be cross-connected so as to serve as emergency boiler-feed pumps, an arrangement somewhat as shown in Fig. 2 can be used with advantage. In this scheme all the suction headers are run along the wall close to the floor back of the pumps and the discharge headers are carried along the same wall immediately above. Branches from each suction and discharge header are taken off at each pump and connected together, entering and leaving the pump through a common valved line.

The way this piping would be arranged in plan view is shown in the sketch, Fig. 3, but for the sake of clearness the strainers and relief valves have not been shown in either drawing; these, of course, would come on the branch into the pump and not on the separate branches from the mains.

With three pumps so connected any one pump can be used for any given service by properly manipulating the valves to handle such service.

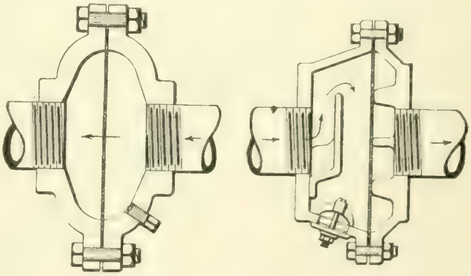


FIG. 1.—COMMON FORMS OF STRAINERS FOR BOILER-FEED PUMPS.

On the steam end more diversity with fewer pipes is practiced. This is because, while there is never anything to consider on the steam end except steam and exhaust pipes. the matter of pump control results in several methods of piping being used. The simplest form of steam and exhaust connections is shown in Fig. 4 where a steam line is carried down to the pump and the pump controlled by a globe valve. This line, however, when the pump is closed down—will fill up with water; before starting the pump the drip valve should be opened on the blow-off line and this water allowed to empty out. The exhaust is dripped, generally through a trap,

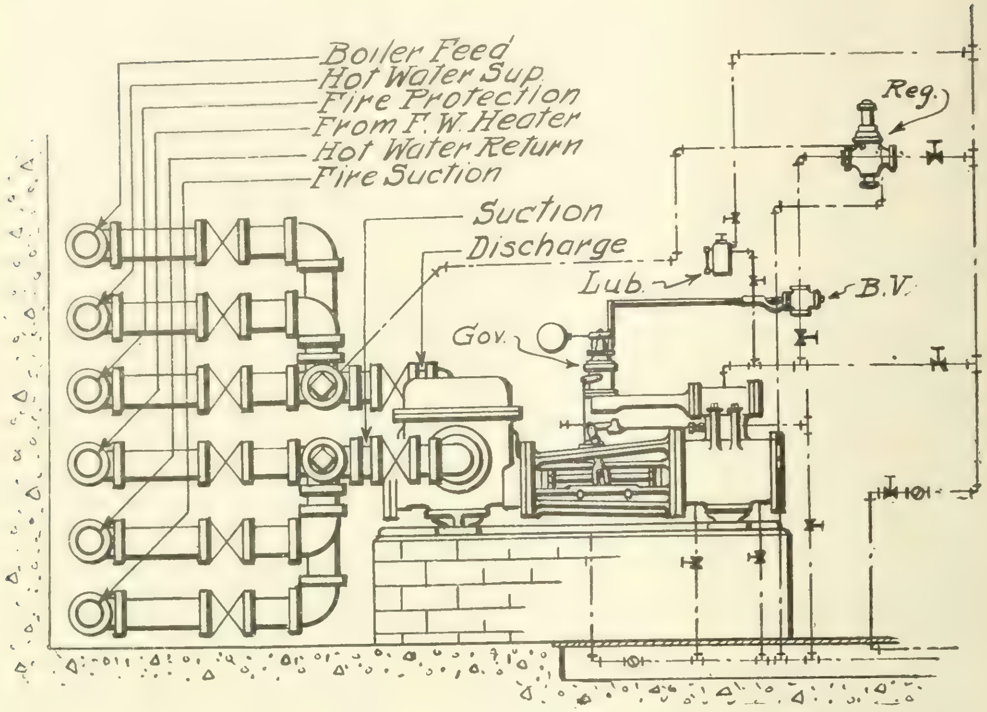


FIG. 2.—TYPICAL ARRANGEMENT OF PIPING WHERE PUMPS ARE CROSS-CONNECTED FOR EMERGENCY SERVICE.

although this, too, can be allowed to go to the blow-off tank or sewer by cracking the drip valve slightly. Such piping is entirely non-automatic and is only used where the work installed must be of the cheapest or the operation of the plant placed in charge of inferior help.

The fact should not be lost sight of that the reciprocating steam pump, to a great extent, duplicates the common steam engine as far as the steam cylinder is concerned. While the steam is not used expansively in the cylinder still cylinder drips are advisable and an endeavor to keep the steam cylinder free from water and to provide it with dry steam is quite necessary for satisfactory operation.

MAKING BOILER-FEED PUMPS AUTOMATIC

The first step in making the boiler-feed pump an automatic proposition consists of placing a trap on the high-pressure steam line so as to keep the drop free from water at all times. This is so simple that the reader is already prepared to take the next step which consists of controlling the pump from the discharge pipe pressure by a pump regulator placed in the steam line supplying the pump. Most of such regulators are constructed on the principal of having a small pipe (connected to the discharge line of the pump) carried up and connected to a chamber located on one side of a diaphragm. On the other side of the diaphragm is placed another chamber connected by a pipe to the steam supply.

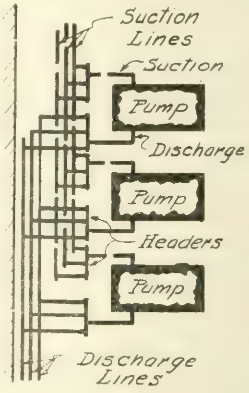


FIG. 3.—PLAN OF PIPING SHOWN IN FIG 2.

Thus the diaphragm is separating two opposing forces and, as the steam pressure is

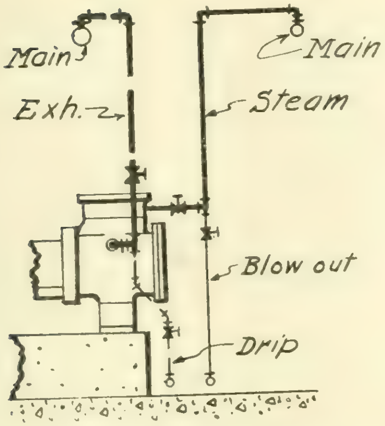


FIG. 4.—SIMPLE FORM OF STEAM AND EXHAUST CONNECTIONS.

always lower than the pressure required to feed in the water against it, the diaphragm on the steam side is assisted by the addition of a spring of sufficient force not only to counteract the difference in pressure, but which can also be adjusted so as to hold any desired higher pressure on the water side.

The installation of such a regulator is indicated with dot and dash lines in Fig. 2 while an enlarged detail of the steam and exhaust connections is shown in Fig. 5, the location of the regulator (Reg.) being in the steam line to the pump. The lubricator (Lub.) is set in a steam pipe by-pass so as to be shut off independently of the other equipment.

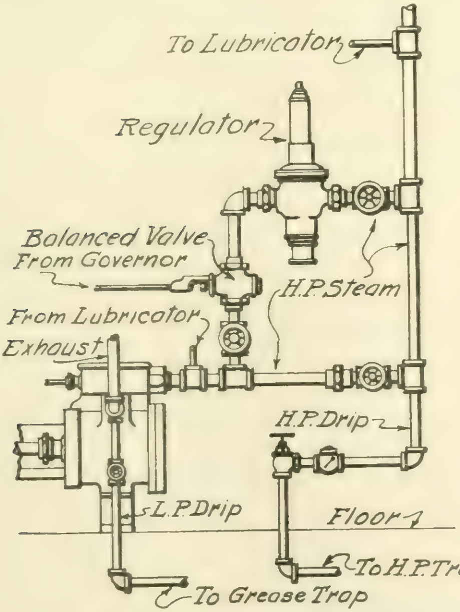


FIG. 5.—DETAIL OF STEAM AND EXHAUST CONNECTIONS FOR BOILER-FEED PUMP.

To control the pump so that it will not exceed a given speed and to prevent its racing or slamming, should the pressure ever be released suddenly on the discharge line, a governor (Gov.) is used, this governor being connected to the piston and shutting down the steam supply through the rods connected with the balanced valve (B.V.) which acts regardless of the control supplied by the regulator. In other words, the regulator starts and stops the pump but the governor determines the speed of operation after the pump has been started. It must be understood, however, that this sort of control is only partially automatic. That is to say, the pump maintains any certain pressure on the line but does not feed the boiler, the actual feeding being controlled by hand-operated valves manipulated by the fireman.

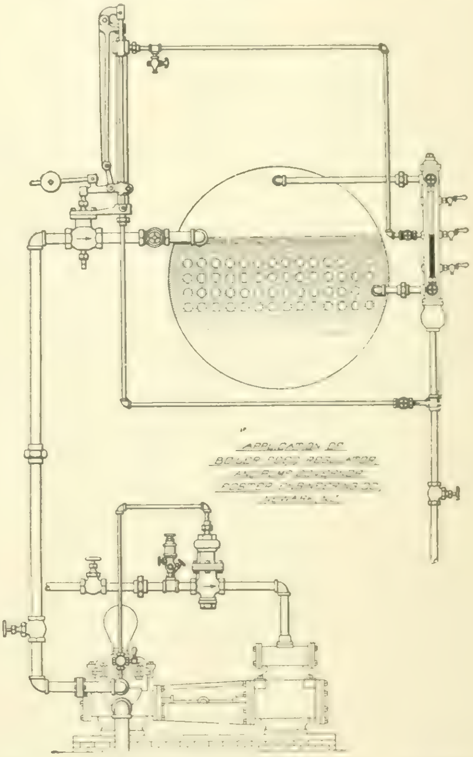


FIG. 6.—DEVICE FOR MAKING BOILER FEEDING AUTOMATIC.

There is still another device which makes the boiler feeding positively automatic. This is illustrated in Fig. 6, the detail of the operating mechanism being shown in Fig. 7. With this apparatus the controller is set at any convenient point and the pipe to the controller is tapped into the water column at the height it is desired to maintain in the

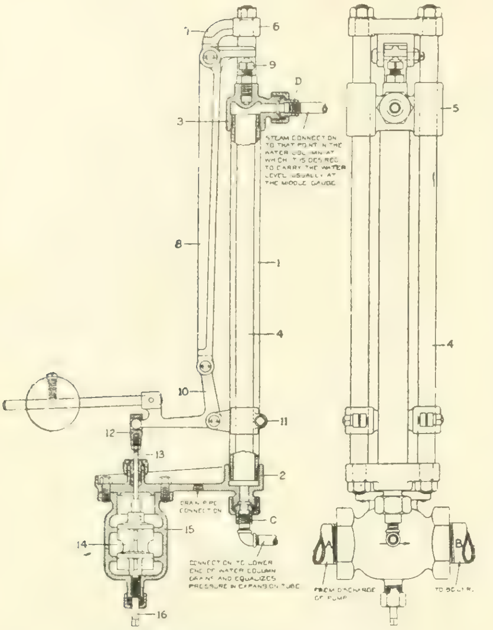

7
6
9
D
3
5
STEAM CONNECTION TO THAT POINT IN THE WATER COLUMN AT WHICH IT IS DESIRED TO CARRY THE WATER LEVEL USUALLY AT THE MIDDLE GAUGE
8
1
4
4
10
11
12
13
2
DRAIN PIPE CONNECTION
C
15
14
CONNECTION TO LOWER END OF WATER COLUMN DRAINS AND EQUALIZES PRESSURE IN EXPANSION TUBE
FROM DISCHARGE OF PUMP
TO BOILER
16

FIG. 7.—CONSTRUCTION OF AUTOMATIC BOILER FEEDING DEVICE.

water line. When the water line falls below this point, steam enters the pipe but when it rises above the proper level it seals the pipe and prevents steam getting to the controller.

When the water in the boiler or water column seals the end of the pipe leading to the top of the expansion tube, so that steam is excluded therefrom, the tube cools and contracts. In this condition of the expansion tube the long arm of the bell crack lever "8" is free to swing outward from the expansion tube and allows the weight to depress the arm of the lower bell crank "10," so as to slide valve "14" downward into closed position, cutting off and preventing water from entering the boiler through the feed line.

When the water recedes below the predetermined boiler level it uncovers the opening in the pipe leading from the water column to the top of the expansion tube and permits steam to enter the same. This heats and expands tube (Figure 1) carrying the adjusting screw "9," which can be set for and desired variation, upward against the short arm of bell crank lever "8," thus swinging the long arm of the latter inwards or towards the expansion tube. This carries the lower bell crank lever "10" and raises the weight, drawing valve "14" upward, opening the main feed valve, permitting water to flow through the feed pipe into the boiler. The flow continues until steam is again cut off from the expansion tube "1," allowing the contraction of the latter sufficiently to close valve "14."

Notes

The Harrison Safety Boiler Co., Philadelphia, Pa., has perfected a new type of open-feed water-heater which is known as a "steam-stack and cut-out valve heater." The heater, which embodies all the good features of the old Cochrane heaters, has, in addition, an extra large oil separator, a three-way valve so that the exhaust steam may be directed entirely into the heater, entirely to the atmosphere or any graduation between the

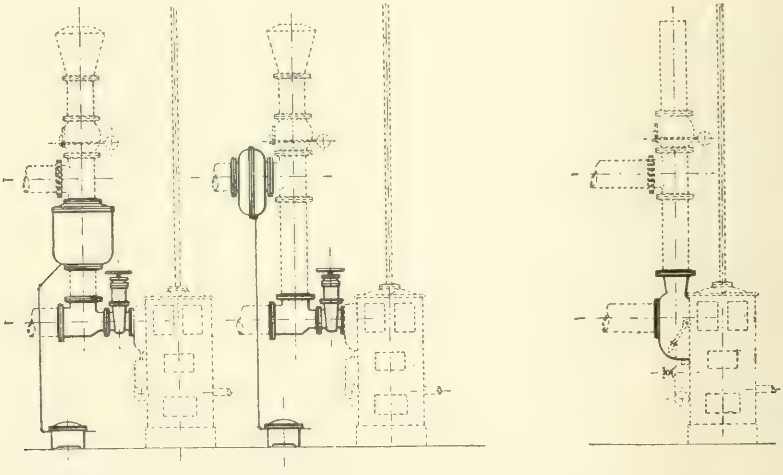


FIG. 1. FIG. 2. FIG. 3.

NEW TYPE OF OPEN-FEED WATER HEATER.

two. This heater eliminates considerable cost in fittings, valves, oil separators and trap as can be seen by reference to Figs. 1, 2 and 3. Figs. 1 and 2 are two standard methods of connecting the old style of heater and Fig. 3 the method used with the steam-stack heater. It is claimed that the cost of fittings and labor thus saved will pay 70% of the cost of the heater.

The Gardner Governor Co., Quincy, Ill., has made a large assortment of apparatus for over fifty years. Their line embraces air compressors, duplex steam pumps, steam and oil separators, engine governors, etc.

The Standard Steam Specialty Co., New York, is the manufacturer of the Utility exhaust head which is designed on the condenser principle, with air circulating tubes and a series of deflector plates so that only dry steam is allowed to escape.

The War and the Heating Engineer

Heating Men in Military Service.

Don R. Marsh, production manager of the Buffalo Forge Co., Buffalo, N. Y., has given up his work to assume similar duties at Washington in the production of ammunition. Mr. Marsh will receive a captain's commission. Charles C. Cheyney, manager of the company's Chicago office, has been given a commission in the Naval Aeronautic Corps and is beach engineer at Pensacola, in charge of aeroplane engines. C. F. Goodrich, assistant manager of the company's Boston office, has left for active duty as first lieutenant in the Ordnance Department. He is stationed at Watervliet Arsenal.

J. C. Latimer and Allen B. Stiles, of Crane Co., Chicago, have received commissions as second lieutenants in the National Army and are stationed at Camp Grant, Rockford, Ill. Lieut. Stiles is the son of R. B. Stiles, assistant treasurer of Crane Company and Lieut. Latimer was formerly connected with the company's engineering department.

Captain C. G. Denison, formerly assistant credit manager of the American Radiator Co., is now stationed at Camp Grant, Rockford, Ill. Joseph S. Barker, Alexander T. Burr and C. S. Gardner, of the same company, who entered the service, are now in France.

Albert W. Hills, formerly western manager of the Haydenville Co., Haydenville, Mass., who has been serving with the scout patrol on the Atlantic coast, suffered a fracture of the arm recently. He is recuperating at the Navy Hospital.

Paul Wagenseller, son of C. N. Wagenseller, manager of the advertising department of the H. Mueller Mfg. Co., Decatur, Ill., has been given a commission as second lieutenant in the Reserve Officers' Training Camp at Fort Sheridan and is now on duty at Camp Grant, Rockford, Ill. Two other sons of Mr. Wagenseller are also in the service, Dean being a private at Camp Grant, and Kirk Wagenseller, in the signal corps on board the U. S. S. Michigan.

William Boyd, son of Charles J. Boyd, a former president of the National Association of Master Plumbers, is serving in the Quartermaster's Department of the National Army, with the rank of corporal.

Among the members of The American Society of Heating and Ventilating Engineers who are on active duty are R. S. Bull, of Chicago, who is a lieutenant at Camp Grant; Ben Nelson, who is at the officers' training camp at Fortress Monroe; C. C. Cheyney, of Chicago, who is an ensign in the aviation department of the navy, on duty at Pensacola, Fla.; and L. C. Monroe, who is stationed at Camp Grant.

W. M. Pattison, president of the W. M. Pattison Supply Co., Cleveland, O., has been commissioned major in charge of supplies of the Quartermaster's Department.

H. S. Haley, member of the firm of Leland and Haley, consulting mechanical and electrical engineers, San Francisco, Cal., is at present at the Llewellyn Iron Works, Los Angeles, Cal., in the interest of the United States Shipping Board Emergency Fleet Corporation, on one of the largest marine boiler contracts placed on the Pacific Coast.

Men Needed for Quartermaster's Enlisted Reserve Corps.

The Quartermaster's Enlisted Reserve Corps, with recruiting headquarters at 357 Broadway, New York, has received a new authorization to enlist men to follow ther civilian trades in the army, for duty in this country and abroad. The men particularly needed at this time are electricians, tinsmiths, iron workers, carpenters, plumbers, mechanics (auto), mechanics (general), masons, bricklayers, farriers, horse-shoers, saddlers, blacksmiths, teamsters, cooks, chauffeurs, stenographers and wagemasters. Those enlisting must be between the ages of 18 and 45 years and have no one depending on them for support. Military training as a soldier is not required in this branch of the service. Those in the drafted list may qualify for this service.

Securing Stenographers for the Ordnance Department.

J. Irvine Lyle, secretary and manager of the Carrier Engineering Corporation, New York, has been appointed chairman of a committee to enlarge the personnel of the Gun Divsion of the Ordnance Department, in Washington. Mr. Lyle's appointment was made by Major-General William Crozier, chief of ordnance, and the committee's work will be devoted more particularly to the securing of some 500 additional stenographers for the gun division. An equal number of draftsmen is required by the gun division and another committee is engaged in securing these men.

Government Orders.

Farnsworth Co., Conshohocken, Pa., reports a U. S. government army engineers' order for fourteen 2½-in. Farnsworth duplex boiler feeders for camps, each machine being capable of feeding 750 h.p. of boilers. They feed water into the boilers at a temperature of over 300° F. with a saving in coal of 10% for every 100° difference.

The New Food Pledge.

A new form of food pledge for men and all those not directly in charge of a household has been adopted by the United States Food Administration and was the basis of a national campaign during the week beginning October 28, when every resource of publicity and organization was enlisted to secure signatures to the food pledge all over the United States. The form is given herewith. Any of our readers who have not already signed this pledge may use the accompanying form which should be signed, clipped and sent to the United States Food Administrator in your State or to the Food Administration, Washington, D. C.

To the United States Food Administration:

I pledge myself to use the practical means within my power to aid the Food Administration in its efforts to conserve the food supplies of the country, and, as evidence of my support, I wish to be enrolled with yourselves as a volunteer member of the Food Administration.

Name ....

Street ....

City ....State ....

There are no fees or dues. We want your help, in the form both of your personal efforts to economize food and your influence with others toward food economy and wise control of our national supply. If you will give this help it will be a direct service to your country.

As member of the United States Food Administration you can directly aid the Food Administration and help win the war by: (1) Eating as little wheat bread or other wheat products as circumstances permit, and, if possible, not more than once daily; (2) eating meat (beef, mutton, or pork) not oftener than once a day; (3) economizing in the use of butter and discouraging the excessive use of other fats; (4) cutting your daily allowance of sugar in tea or coffee, and of sweet drinks, candy, and in other ways helping to lessen the consumption of sugar; (5) eating more corn, rye, vegetables, fruit, fish, and poultry in place of wheat and meat; (6) avoiding waste of all kinds; and (7) urging in your own home or the restaurants you frequent the necessity of economy in food, and requesting the observance of these pledges by other persons.

Our problem is to feed our allies this winter by sending them as much food as we can of the most concentrated nutritive value in the least shipping space. These foods are wheat, beef, pork, dairy products, and sugar.

Our solution is to eat less of these and more of other foods of which we have an abundance, and to waste less of all foods.

Ordnance Corps in Need of Skilled Men.

Skilled men in many lines of trade are urgently needed in the Enlisted Ordnance Corps of the National Army, according to a communication sent out through the office of the chief of ordnance. This corps, into which the Ordnance Enlisted Reserve

Corps has been merged, is charged with the supply, maintenance and repair of all cannon and artillery vehicles and equipment, all machines for the service and manouver of artillery; in fact, it is the army known as "service of the rear." There is a place for practically every man who knows a trade in this corps. Machinists, mechanics, plumbers, etc., are especially needed at this time. Those accepted for enlistment will ultimately see service abroad. Application blanks may be had from Chief of Ordnance, Enlisted Personnel Division, Washington, D. C.

Government Still in Urgent Need of Stenographers and Typewriters.

The United States Civil Service Commission is calling fresh attention to the war need of the government for stenographers and typewriters. Women especially are urged to undertake this office work. Examinations for the department are held every Tuesday in 450 of the principal cities of the United States and applications may be filed with the commission at Washington at any time. The entrance salary ranges from $1,000 to $1,200 a year. Applicants must have reached their eighteenth birthday on the date of the examination. Full information in regard to the scope and character of the examination and for application blanks address the U. S. Civil Service Commission, Washington, D. C., or the secretary of the U. S. Civil Service Board of Examiners in Boston, New York, Philadelphia, Atlanta, Cincinnati, Chicago, St. Paul, St. Louis, New Orleans, Seattle, San Francisco, Honolulu, or San Juan, Porto Rico.

War Service Committees Being Organized in Various Industries.

To bring about an immediate action by American business on the resolution passed at the recent war convention in Atlantic City, recommending that each industry from a committee to represent that industry and to serve as a connecting link between it and the government, a committee of the Chamber of Commerce of the United States suggests, among other things, that all branches of each industry be represented on the committee, whether members of a trade organization or not; also that the committee should include representatives of some of the smaller units of the industry, as well as the larger; and that sub-committees of the important branches of the industry be appointed to cooperate with the war service committee wherever possible.

Many lines of industry, it is pointed out, are seriously affected by inability to get necessary material or labor and face serious problems for the future in connection with the shifting of labor from one community to another. Furthermore, the government, to procure war materials and supplies in the vast quantities required, needs the advice and assistance of men having thorough acquaintance with each industry. Also, the government is confronted with great problems in connection with the regulation of prices and distribution and to avoid unnecessary interference with business, and needs at its service the practical knowledge and experience which could be furnished by such committees.

War service committees might undertake the following:

1. To assemble accurate information with respect to the facilities of the industry, the possibilities of expansion or the readjustment of plants and equipment to meet the ever increasing requirements of the government.

2. To arrange for the gathering of figures as to cost of production in the industry including conditions which were changing the cost of production. In this respect the committee would furnish to the government information which would prevent avoidable hardship in the business by government regulation of prices or distribution.

3. To act with the Priority Committee of the War Industries Board which is establishing principles governing the distribution of materials in transportaton and the order in which various products are to be produced and distributed.

4. New facilities are being created and there is great shifting of labor from one section of the country to another. War service committees could offer suggestions regarding the use of existing facilities or the employment of labor in districts of the country where needed after the war.

5. These committees should be ready at all times to meet with any of the Departments of the Government whenever their advice is desired, to discuss questions affecting the industry raised by the war needs of the government.

The appointment of a war service committee to represent the heating and ventilating trade has already been made by President J. Irvine Lyle of the American Society of Heating and Ventilating Engineers.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Officers Nominated for 1918.

The following nominations have been made by the nominating committee of the American Society of Heating and Ventilating Engineers, Frank T. Chapman, chairman:

For president, Frederick R. Still, Detroit, Mich.; for first vice-president, Walter S. Timmis, New York City; second vice-president, E. Vernon Hill, Chicago; treasurer, Homer Addams, New York City; Council, J. Irvine Lyle, New York City; W. H. Driscoll, New York City; Howard H. Fielding, Denver; H. P. Gant, Philadelphia; Charles W. Kimball, Boston; Frank G. Phegley, Cleveland; Fred W. Powers, Chicago; and Champlain L. Riley, New York City.

Secretary C. W. Obert, who is also secretary of the Boiler Code Committee of The American Society of Mechanical Engineers, recently visited a number of mid-western cities in the interest of the boiler code and incidentally called on members of the heating engineers' society in Columbus, Detroit, Indianapolis, St. Louis, Kansas City, Chicago and Toronto. He also attended the convention of the stationery engineers in Evansville.

Committee to Report on Health Conditions in Workshops.

In response to a request from Samuel Gompers, head of the committee on labor of the National Council of Defense, that a representative from the heating engineers from each State be appointed to join with a sub-committee of the council, President J. I. Lyle has named Jay R. McColl, dean of engineering in the University of Detroit, to act as Michigan's representative.

The joint committee will be composed of representatives of scientific and engineering bodies. Its chief aim will be to conserve the efforts of wage earners during the war.

Committee to Confer with National District Heating Association.

The council of the heating engineers' society has appointed the following committee to confer with a similar committee representing the National District Heating Association, having for its object a closer co-operation between the two organizations: J. Irvine Lyle, chairman; A. S. Armagnac, W. H. Driscoll, C. W. Obert and Frederick R. Still. The National District Heating Association will be represented by President George W. Martin and Secretary D. L. Gaskill.

Eastern Pennsylvania Chapter.

The Eastern Pennsylvania Chapter devoted its first meeting of the season to a discussion of "Coal Conservation." Secretary George Boon has sent out a year book of the chapter, containing the names and addresses of the members, and including a history of the chapter, together with its constitution and by-laws.

Kansas City Chapter.

The Kansas City Chapter held its first meeting of the season September 14, when Secretary C. W. Obert was in Kansas City. Mr. Obert addressed the chapter, giving an account of the work being done for the government by members of the society. F. A. DeBoos also spoke, his remarks including a review of the society's recent summer meeting in Chicago. President H. W. Whitten presided.

The annual meeting of the chapter was held at the University Club, Kansas City, October 5, when the following officers were elected: President F. A. DeBoos, formerly secretary of the chapter; vice-president, Walter E. Gillham; secretary, John H. Kitchen; treasurer, T. J. McMorran. Members of the council B. J. Natkin (chairman), William M. McIntyre and John B. Pease.

A paper was presented by D. T. Taylor on "Estimating the Cost of Heating Buildings." Fifteen new members were elected, making a total for the Kansas City Chapter of 41 members. The programme committee is at work on the subjects to be considered at each meeting for the year. Special committees will be in charge of each meeting.

Michigan Chapter Elects Officers.

The first regular meeting of the Michigan Chapter for the season was held October 8 at the Fellowcraft Club, following a chapter dinner. The principal speaker was Lieutenant Samuel Eckert of the Selfridge Aviation Corps at Mount Clemens, Mich., who told of the extensive preparations being made at Mount Clemens for training and equipping the aviation service.

New York Chapter Addressed by Army and Navy Officers.

Some of the wonders of the huge army cantonments were presented at the opening meeting of the New York Chapter, which was held at the Building Trades Club, October 15. The meeting was preceded by the usual chapter dinner, the guests of honor being Major O. K. Myers, construction quartermaster of Camp Upton, at Yaphank, L. I., Captain L. H. Tripp, of the Quartermaster's Department in Washington, and Commander Harris of the U. S. S. Maine.

At the conclusion of the dinner President Frank K. Chew addressed the members, calling attention to the programme for the year which had been prepared. He then turned over the meeting to Walter S. Timmis, chairman for the meeting. Mr. Timmis referred briefly to the mechanical equipment for Camp Upton which was designed by him and presented Major Myers who spoke on the difficulties and the plan and scope of the work at Camp Upton. He said that in addition to the regular sixteen army cantonments for the draft army there are eighteen additional encampments for the National Guard of the various States and in connection with the embarkation stations.

ENTIRE CAMP BUILT IN SIXTY DAYS.

At Camp Upton, where there are now 1,200 acres of buildings, the work of clearing the ground was not begun until July 5. In handling the construction work, three methods were possible: to consult with engineers, to deal with engineers who had an organization and, third, a combination of the two. The third plan was adopted. Typical plans of the various buildings were used and the contractors' work divided into purchasing, tracing, accounting and construction departments.

As giving some idea of the extent of the cantonment, Major Myers said that 3½ miles of wood stave pipe were used for carrying water this pipe being 8 in. and over. Eighteen miles of iron and steel pipe under 8 in. were installed. In addition to the 1,200 acres already in use, 2,000 acres additional will be cleared for drill purposes. An immense central heating plant is installed for the hospital group of buildings, while the officers' quarters are separately heated by individual steam heating plants and the barracks themselves have stoves. The refrigerating plant is of 20-ton capacity, while the laundry is one of the largest in the United States.

At one time 14,000 men were employed in the construction of the camp. This number constantly varied owing largely to the pest of mosquitoes which often made sleep impossible.

WORK OF QUARTERMASTER'S DEPARTMENT.

The next speaker, Captain Lewis H. Tripp, told of the work of the Quartermaster's Department in Washington in getting out the first plans for the cantonments which served as a general standard. He said, among other things, that hot water was furnished only for showers, this having the effect of forcing the men to bathe frequently. There are 30 kitchens in each cantonment and 9,000 ranges for the sixteen cantonments. The bakeries are in continuous operation and turn out 18 tons of bread every 24 hours. He admitted that as a general proposition steam heating would have been favored above furnace heat, but that the element of time was necessarily the deciding factor.

In running the steam pipe lines, it was found in many cases cheaper to run the pipes overhead, suspended on telegraph poles instead of underground. They were covered with 1-in. air cell covering over which was placed a layer of 1-in. hair felt, the whole being enclosed in water-proof roofing paper bound on with twine.

The typical barrack buildings are 43 ft. wide by 140 ft. long, with three dormitories, each 40 x 50 ft., and a mess room 40 x 50 ft. In figuring the heat losses the coefficients used were 0.25 B.T.U. for walls and ceilings, 0.3 for floors which were lined with building paper, 1 for glass and 2.4 for each lineal foot of crack. These allowances were figured to heat the barracks to 60° F. in extreme weather. For the ventilation, it was figured that 400 B.T.U. per hour would be given off by each man and allowing 1,600 cu. ft. per hour per man would result, it was estimated, in maintaining a temperature of 50°. Coal used was estimated at 12,000 B.T.U. per pound.

For those interested in figures he stated that nearly 1,000,000 ft. of stove pipe had been used in the various cantonments, 1,700 castiron boilers with a total capacity of 3,200,000 sq. ft. of radiating surface, 265 steel boilers aggregating 3,160,000 sq. ft. of radiating surface and 3,000,000 ft. of steam and water piping.

There is a base hospital at every cantonment containing from 600 to 1,000 beds. These buildings are provided with low pressure steam for heating, high pressure steam for sterilizers, etc., a hot water circulating main and hot water heaters heated with live steam.

W. H. Driscoll, of the Thompson-Starrett Company, which has the power and heating contract at Camp Upton, then spoke, and gave a vivid account of the almost insurmountable difficulties encountered in the course of the work, which was under his direct supervision. He referred to the spirit of the drafted men as being remarkably fine.

The next speaker was Commander Harris. He said the navy was about to undergo a new experience in wintering in northern, rather than in southern waters, and that the heating accommodations would undergo a test decidedly different from anything previously experienced.

The concluding speaker was President J. I. Lyle who told of the urgent need of the gun division of the ordnance department, in Washington, for 300 draftsmen and 400 stenographers. The design of trench ammunition, he said, is in constant need of redesigning due to the changes in methods and it is necessary to have a large force of designers to keep up with these changes.

The November meeting will be in charge of a committee headed by Conway Kiewitz. The chairmen for the subsequent meetings are as follows: December, W. F. Goodnow; January (annual meeting of the society) H. G. Issertell; February, W. L. Fleisher; March, C. E. Scott; April, Frank T. Chapman; and May, B. K. Strader.

New Officers for Illinois Chapter.

New officers were elected as follows at the opening meeting of the Illinois Chapter, held October 8 at the Engineers' Club, Chicago: President, Dr. E. Vernon Hill; first vice-president, G. W. Hubbard; secretary, A. E. Stacey; treasurer, August Kehm, Members of the council: Dr. E. Vernon Hill, Fred W. Powers, J. F. Tuttle, G. W. Hubbard and George Mehring.

The retiring president, Fred. W. Powers, expressed his appreciation of the support accorded him during his term of office and especially in connection with the summer meeting of the society in Chicago last July. A rising vote of thanks was given the officers.

It was announced that the chapter now has 97 members. The report of the auditing committee showed the chapter to be in a healthy financial condition.

It was voted to remit the dues of all members who are on war service.

Suggestions of topics for future meetings included "The Heating of Army Cantonments," and "Proper Methods of Testing Ventilating Installations." The new president, Dr. Hill, urged the members to contribute more papers for the society's meetings. Harry M. Hart gave an interesting account of the heating equipment at the Great Lakes Naval Training Station at Waukegan, Ill., which was installed by the L. H. Prentice Co., Mr. Hart being in direct charge of the work. (A brief account of this installation was published in last month's issue). George Mehring followed Mr. Hart with a description of the heating for the barracks at the same point.

Upon motion by J. F. Tuttle, it was voted to appoint a committe to determine certain standards for methods and apparatus in heating and ventilating work. A motion was then made by F. W. Powers and carried that a committee be appointed to report at the next meeting concerning the feasibility of creating a fund for test work in connection with the proposed standardization of methods and apparatus.

◆

Institution of Heating and Ventilating Engineers.

In spite of the fact that England is engrossed in the war, the Institution of Heating and Ventilating Engineers is proceeding with the research plan that has been carried on at University College. This work was started by a grant from the London City Council of £300. The Government Department for Scientific Research has now proposed to make a grant of £225 per year for the next two years, on condition that the institute contribute a further sum of at least £150 and that the total amount of £600 should be expended during the two years on certain stipulated work. This offer the council of the institution has accepted, and is now appealing for further funds from its membership.

The research work in question consists largely in securing data from tests for establishing what are to be known as "British" standard co-efficients of heat losses through building materials.

◆

American Association of Engineers.

Secretary A. H. Krom, of the American Association of Engineers, whose headquarters are at 29 South La Salle Street, Chicago, has recently completed a tour of eastern cities to interest local engineering clubs and societies in a plan for national affiliation. The idea is to develop a national organized effort to promote business for the engineers and in this connection to handle the problems of national distribution of engineering service and national publicity.

◆

Plan for Interesting Men in Technical Meetings.

In order to provide the kind of meetings desired by its members, the New York Section of the American Society of Mechanical Engineers is asking its members to indicate, on a return postal card, the character of papers desired and the carrying out of certain social features. Under "Character of Papers" are given "popular," "military," and "semi-technical." For those who desire technical papers space is left to indicate "what subjects." The members are also asked to state whether they prefer the get-together dinner at some hotel before the meeting, as practiced for the past two years, or whether a light supper, served in the Engineering Societies Building at nominal cost, would better solve the acquaintanceship problem.

CORRESPONDENCE

Use of Kerosene Oil for Steam Boilers.

EDITOR, HEATING AND VENTILATING MAGAZINE:

Do you know of a steaming system where kerosene oil is used for fuel? I am in need of something to cook jellies and syrups without using wood for fuel. The Department of Commerce at Washington has referred me to you.

F. B. NORDMAN, JR.

Ormond Beach, Fla.

The use of kerosene oil as a fuel for steam boilers is rather unusual, owing to the fact that wherever it is possible to obtain kerosene it is also usually possible to obtain other fuels with cheaper and more satisfactory nature. It is assumed that our correspondent will require for cooking jellies, etc., steam between 40 and 60 lbs. pressure for which purpose we can refer him to at least one manufacturer who builds boilers for kerosene.

These boilers are made anywhere from one to forty horsepower. The boiler is arranged with a gas burner, but a kerosene burner can be substituted, if desired. Even the manufacturer, however, is not very enthusiastic about kerosene as he points out that he has practically discontinued the manufacture of such boilers, now building gas-fired boilers almost exclusively. He also states that the kerosene boiler is quite efficient but not as convenient to use as the gas-fired boiler, requiring more attention; if gas rates are close to the average the kerosene boiler would possibly be more economical.

The kerosene burner is, therefore, perfectly practical, but may affect the insurance rates, while a gas-fired boiler will not cause any such increase. The pounds of water evaporated per pound of fuel burned will vary with the size and type of boiler. We would advise our correspondent to use either a coal or gas-fired boiler or to substitute crude oil for kerosene as a fuel.

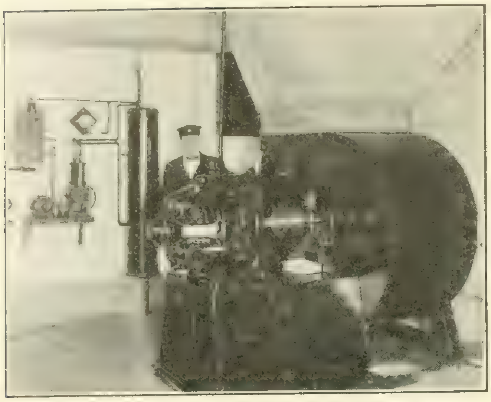
◆

Ventilating Equipment of the Brooklyn Trust Building.

In the building of the Brooklyn Trust Company at 177 Montague Street, Brooklyn, forced ventilation is supplied throughout by motor-driven fans. The main supply fan has a capacity of 18,000 cu. ft. per minute at 295 r.p.m. and is driven by a 12.5 h.p. motor. It cares for the banking room and corridors on the first floor and the directors' room on the second. The main exhaust fan is driven by a 7.5 h.p. motor; it has a capacity of 11,000 cu. ft. per minute at 268 r.p.m. This takes care of all floors. An additional fan for the basement has capacity of 11,000 cu. ft. per minute at 300 r.p.m.; it is driven by a 5 h.p. motor. The speeds of all these motors can be adjusted by resistances in the armature and field circuits.

There are two smaller blower units—

MAIN SUPPLY FAN FOR BROOKLYN TRUST BUILDING.



MAIN EXHAUST FAN, BROOKLYN TRUST BUILDING.

one of 4,000 cu. ft. per minute capacity for the boiler room exhaust and one of 6,000 cu. ft. for the toilet room exhaust. These are driven by 1 and 3 h.p. motors respectively. The main exhaust discharges into the boiler room, supplying in winter warm air for the furnaces.

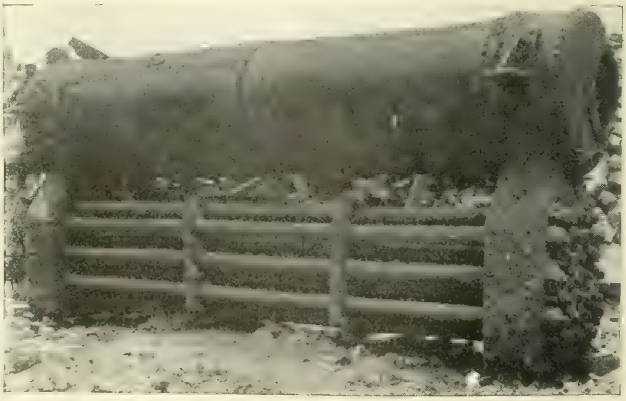
All motors are for direct current of Westinghouse make. The fans are of the Sirocco type. The heating and ventilating installation was engineered by Almiral & Co., New York.

◆

The First Heine Boiler.

After a fire which destroyed the National Guard Armory in St. Louis, Mo., a few months ago, the Heine Safety Boiler Co., of that city obtained possession of the first Heine boiler ever built, which was installed at the armory in 1881. This little boiler is shown in Fig. 1, just as it was removed.

It has 24 tubes about 10 ft. long the heating surface is approximately 250 sq. ft., making the rating of the unit 25 h.p. The boiler was built in the shop of Richard Garstang, St. Lous. The original pressure for which it was designed was about 100 lbs. and an inspection certificate from the Fidelity & Casualty Co. has been received to the effect that they will certify this boiler to carry 80 lbs. pressure at the present time.



FIRST HEINE BOILER EVER BUILT, TAKEN FROM ST. LOUIS BUILDING.

This indicates a somewhat longer life for water-tube boilers than is usually credited them by accountants or engineers when apportioning depreciation changes. However, under modern conditions the heavier loads on boilers would perhaps tend to lessen their life as compared to this little boiler. One odd feature is the casting which forms both the steam outlet and the water column. Another obsolete feature of this boiler is the vertical baffling which was discarded in later designs for the horizontal baffling, now the standard with Heine boilers of both the land and marine types.

◆

Credit Association of the Building Trades Formed in Philadelphia.

After many years of effort, Philadelphia has at last taken equal rank with the building industry of other large cities in the formation of an organization which will be known as the Credit Association of the Building Trades of Philadelphia. One of the association's objects is "to encourage trade, receive and supply to the members information as to commerce, exchange, credits, markets; to compose differences, to collect debts and in all lawful ways to conserve and advance the business interests of its members." The board of directors is composed of representatives of the various building trade sections and permanent officers have been elected as follows: President, A. D. Weber; treasurer, William P.

Thompson; secretary, M. G. Sellers, who is also secretary of the local master steam fitters' organization in Philadelphia; executive committee: A. D. Weber, mill work; William P. Thompson, steam fitting; R. C. Williams, Jr., electric work; E. P. Henry, tile; H. W. Geshwind, cement and asphalt. Officers and headquarters have been established at 1518 Sansom Street, Philadelphia.

◆

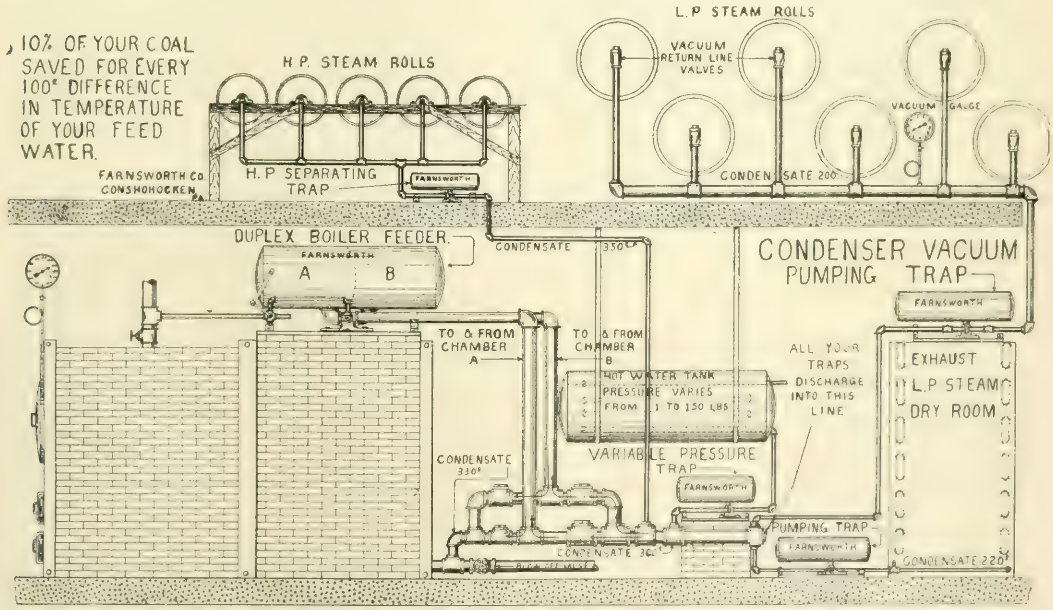
Typical Arrangement of Boiler Feeder Apparatus.

A design showing the several types of Farnsworth machines for handling the conditions involved in the average power and heating plant, without relation to specific types of apparatus, machine or general piping design, is shown in the accompanying illustration. It brings out, among other things, the temperature of the condensate under the various conditions as applied to those usually existing in this kind of a job, and particularly the temperatures of the condensate under the different stages before passing into the boiler, and how it is kept under full pressure and fed with a continuous flow directly into the boiler. The separating trap, it will be noted, collects condensate from the high-pressure rolls or from any other source under full boiler pressure and discharges its contents at 350° or over, direct into the general return line. The condenser vacuum trap collects condensate from low-pressure steam rolls under a vacuum, with a temperature of condensate at 200°, and pumps it into the general return lines. The pumping trap collects condensate from the coils in the low-pressure drying rooms at a temperature of 220° and pumps it into the general return line. The variable pressure pumping trap collects condensate from the hot water tank at a pressure of from 1 to 150 lbs. All the other types of high-pressure traps discharge into the same general return line.

The condensate from all of the traps is pumped under full pressure through the two inlet check valves leading to the boiler feeder and is delivered into either chamber A or chamber B of the boiler feeder. Chamber A fills and tilting to the left, operates the control valve and applies steam direct from the main steam line to the top of the water in chamber A which forces the condensate direct into the boiler through its delivery check valve. The admission of the steam into chamber A also preheats it to a certain extent.

While chamber A is delivering condensate at a preheated temperature of 330°, chamber B is receiving condensate from the general return line at about 300°, or at temperatures depending on volume from any particular source.

Among the points emphasized by the


10% OF YOUR COAL SAVED FOR EVERY 100° DIFFERENCE IN TEMPERATURE OF YOUR FEED WATER.
H P. STEAM ROLLS
L.P STEAM ROLLS
VACUUM RETURN LINE VALVES
VACUUM GAGE
CONDENSATE 200°
FARNSWORTH CO CONSHOHOCKEN PA
H. P SEPARATING TRAP
FARNSWORTH
DUPLEX BOILER FEEDER
A
B
CONDENSATE
350°
CONDENSER VACUUM PUMPING TRAP
TO & FROM CHAMBER A
TO & FROM CHAMBER B
HOT WATER TANK PRESSURE VARIES FROM 1 TO 150 LBS
ALL YOUR TRAPS DISCHARGE INTO THIS LINE
EXHAUST L.P STEAM DRY ROOM
VARIABLE PRESSURE TRAP
CONDENSATE 330°
PUMPING TRAP
CONDENSATE 300°
BLOW OFF VALVE
CONDENSATE 220°

TYPES OF FARNSWORTH MACHINES AS INSTALLED IN TYPICAL POWER PLANT.

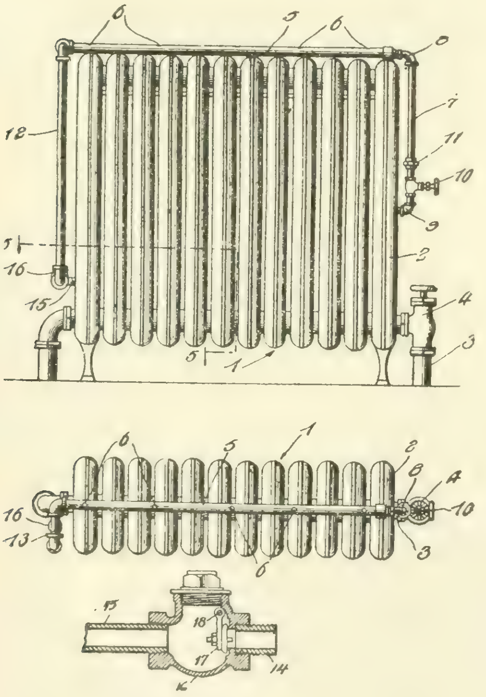
manufacturers in the construction of these specialties are that they are built without trunnions, as the load of the tank is carried on a steel shaft, thus eliminating the load from the packed swing joints; that Tuxedo swing joints are used which are drop-tight at all times; that all machines are built extra heavy; and that Monel metal valves are used on pressures above 125 lbs.

◆

The Monahan Humidifier.

An interesting type of radiator humidifier has been patented by M. C. Monahan, of Dixon, Ill. It is intended to be applied to a steam radiator for ejecting a portion of the steam therefrom into the room. Referring to the accompanying illustration, the radiator is of the conventional type, being provided at the inlet end with a steam inlet having a cut-off valve (4). Extending along the top of the radiator and projecting a short distance beyond the opposite ends is a perforated pipe having spaced perforations disposed longitudinally along its upper surface. The end of the perforated pipe which projects past the inlet end of the radiator is connected therewith by a vertical inlet pipe (7) which is smaller than the perforated pipe.

The flow of steam through the perforated pipe from the radiator is controlled by the cut-off valve (10). This arrangement permits the flow of steam to the humidifier to be regulated without interfering with the flow of steam through the radiator. The opposite end of the perforated pipe which projects from the other end of the radiator is provided with a condensation return pipe (12). Steam is prevented from returning from the radiator to the humidifier by the short-length pipe (13), although permitting the water of condensation to pass through. Mr. Monahan, the inventor is engineer for the North Dixon schools, and is planning to dispose of his invention.



DESIGN OF MONAHAN HUMIDIFIER.

◆

Pressure Regulating Valve for Hot Water Heating Systems.

An interesting type of pressure regulating valve for hot water house heating systems has recently been developed by the Scientific Heater Co., Cleveland, O., and is shown in the accompanying illustrations. A cross-section of the valve is shown in Fig. 1, while Fig. 2 shows the valve attached to a system. The bronze spring at the left holds the inlet valve open until the system is filled and the water pressure overcomes the spring pressure, say, for instance, 20 lbs., when the inlet valve closes. If the boiler is now fired up and the water expands to a point where the pressure over-

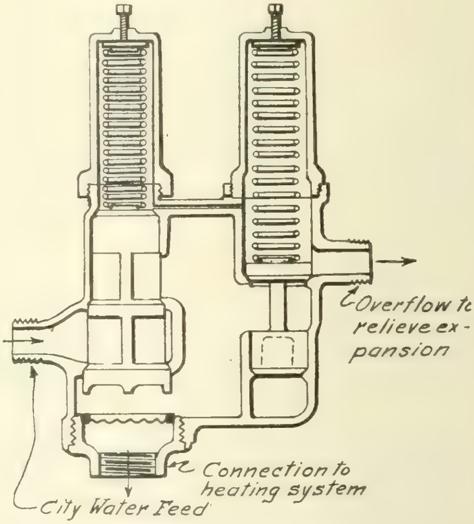


FIG. 1.—CROSS-SECTION OF NEW TYPE OF PRESSURE REGULATING VALVE.

comes the pressure of the spring at the right, say, 30 lbs., this relief valve opens and spill a few tablespoonfuls of water, thus relieving the excess pressure.

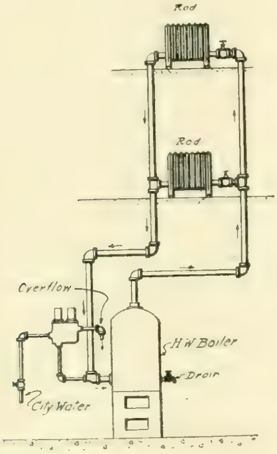


FIG. 2.—HEATING SYSTEM EQUIPPED WITH NEW TYPE OF PRESSURE REGULATING VALVE.

It will be seen that this valve takes the place of an automatic float-feed expansion tank and line of feed piping to basement, and a pressure generator. The valve itself is constructed so that the seats are self-cleaning, the springs are out of the water and any slight leak goes into the overflow pipe.

◆

New Book.

A MUNICIPAL EXPERIMENT, or the Hall of Records Power Plant (New York) by Reginald Pelham Bolton, has been published by the Bureau of Public Service Economics, Inc. It is a book of 236 pages, including index and presents in detail the results of the well-known tests on this plant to determine whether or not it was more economical to install an independent power plant in the building or to purchase electric current from an outside source. In the original test Mr. Bolton represented the New York Edison Company and the present volume is an elaboration of his conclusions from that test, which favored purchase of current from outside sources as a money-saving proposition. The fact that Mr. Bolton has given up the entire contents of the book to the presentation of his data and conclusions is evidence of his confidence in their accuracy. The subject is discussed from the viewpoints of the taxpayers' investment in machinery, ash disposal by municipal methods, surplus exhaust in coldest weather, and burning cheap fuel. The author has the faculty of presenting his data in a very readable form and the book will well repay the perusal of engineers generally.

◆

New Publications.

EFFECTS OF STORAGE UPON THE PROPERTIES OF COAL, by S. W. Parr, is the title of a bulletin (No. 97) issued by the Engineering Experiment Station of the University of Illinois. The investigation showed, among other things, that bituminous coal can be stocked without appreciable loss of heat values, provided the temperature is not allowed to rise above 180° F. The indicated heat loss per pound of coal is due more largely to an increase in weight of a unit mass of coal resulting from absorption than to an actual deterioration or loss of heat units. Freshly-mined coal has a large capacity for absorbing oxygen which combines chemically with both the organic combustible and the iron pyrites present. The combination of oxygen with coal at ordinary temperatures generates a small increment of heat.

The rapidity with which oxygen is absorbed depends upon the temperature of the mass and the extent of the superficial area exposed, that is, the fineness of division of the coal. If heat is generated by this slow process of oxidation more rapidly than it is lost by radiation, the acceleration of the reaction causes a rise in temperature which quickly brings the mass up to the danger point. A temperature of 180° F. is named as the danger point because, if the coal reaches that temperature, practically all of the free moisture is vaporized and the further rise in temperature will be very rapid.

Any method of storage to be successful must either check or prevent the absorption of oxygen to such an extent that the generation of heat shall not proceed so rapidly as to exceed natural heat losses due to radiation.

Underwater storage prevents loss of heat values, and is not accompanied by deterioration in physical properties, such as slacking.

Dry storage is far more safely undertaken if the fine material is screened out at the storage yard and the lump only, preferably sized, is stocked.

Another report on the deterioration in the heating value of coal during storage, covering a 5-year period, has just been issued by the Bureau of Mines, Department of the Interior, as Bulletin No. 136, the authors beng Horace C. Porter and F. K.

Ovitz. The results are of special interest when taken in connection with those above referred to, made at the University of Illinois. They show that the amount of deterioration of coal in heating value during storage has commonly been overestimated. Except for the sub-bituminous Wyoming coal, no loss was observed in outdoor weathering greater than 1.2% in the first year, or 2.1% in two years. The loss in heating value is given for New River and Pittsburgh coals during five years' storage in the open air and under water, for Pocahontas during two years' storage in the air, and for Sheridan, Wyoming, coal during 2¾ years' storage in the air.

The tests with New River and Pittsburgh coal were made to determine the advantage to be gained by storing coal under water, and particularly under salt water. The results show that storage of New River coal under water effectively prevents deterioration of calorific value and that storage in the air under severe conditions causes only small deterioration, about 1% in one year's exposure and about 2% in two years. After two years the loss is continuous but slow, reaching 2.5% to 3% in five years. The deterioration of Pittsburgh coal during one year's open-air storage was practically negligible. During the second, third, fourth and fifth years the deterioration proceeded very slowly and did not reach an amount greater than 1.1% in five years. The submerged portions suffered no loss measurable by the degree of accuracy of the methods used.

Detailed results and a full account of the tests and analytical data are given in the bulletin, which may be obtained free of charge by addressing the Director of the Bureau of Mines, Washington, D. C.

RULES RELATING TO THE CONSTRUCTION, INSTALLATION, INSPECTION AND MAINTENANCE OF STEAM BOILERS, some of which went into effect July 1, 1917 and others which become effective January 1, 1918, are contained in Bulletin No. 14 on the Industrial Code, issued by the State Industrial Commission of the New York State Department of Labor. The rules take up 117 pages. Under "New Installations," rules are given applying exclusively to boilers used for low-pressure steam and hot water heating and hot water supply. A formula is given for determining the maximum allowable working pressure, this portion of the bulletin occupying thirteen pages. The bulletin is published from the Bureau of Industrial Code, 230 Fifth Avenue, New York.

Trade Literature.

SPRAGUE MOTOR-DRIVEN EXHAUST FAN OUTFITS, direct and alternating current, are featured in a new bulletin No. 41,801, superseding No. 246, issued by the Sprague Electric Works, New York. This company has standardized on Davidson fan outfits in sizes from 18-in. to 48-in. inclusive and Ventura fan outfits in sizes from 10¾-in. to 48-in. inclusive, for both direct and alternating current. Special attention has been paid in the design to have the fans compact, light in weight, yet with ample overload capacity. Care has also been taken to have them well-balanced, as noiseless as possible, and with high efficiency. The motors are totally enclosed. All of the necessary data, with drawings showing dimensions, etc., are included. Size 8 x 10½-in. (standard), punched for binding. Pp. 16.

TEMPERATURE REGULATORS, with special reference to the product of the Taylor Instrument Companies, Rochester, N. Y., are presented in a new catalogue (Section 17,000) which will be found especially useful to the engineer and buyer, because it shows many illustrations of varied applications. It is described as the most complete catalogue covering one specific type of temperature regulator which the Taylor Instrument Companies has published and no effort has been spared to show by numerous illustrations, the wide adaptability of these devices.

STOCO PROTECTION GOGGLES, made by the Standard Optical Co., Geneva, N. Y., are the subject of a catalogue recently issued by this company. It is stated that the Stoco goggle may be worn for long periods without discomfort, injury to the vision or eye fatigue. Because of its broad bearing on the nose and face and its flexible temples, it fits snugly without cutting or chafing the nose or ears. Size of catalogue, 5¼ x 7½ in. Pp. 16.

THE EVERLASTING FUEL SAVERS is the description given of the Metaphram line of regulators manufactured by the National Regulator Co., Chicago, and illustrated and described in newly-issued circular matter. The line includes Types A, Jr., A, BC and D, for low pressure and vapor; Type F for hot water and A-Jacks for high pressure. They are made for boilers of any size, style or duty.

AMERICAN HOT WATER HEATING SYSTEM, (tank-in-basement) is described in newly-issued circular matter received from the American Heating Specialty Co., Peru, Ind. The general arrangement of this system is shown in the accompanying illustration

(Fig. 1) while Fig. 2 shows the construction of the differential pressure relief. This device is designed to relieve the excess pressure when accumulated in the system. Every precaution has been taken in the design and construction to prevent clogging with sediment. The diaphragm acts directly upon the disc and exerts a differential pressure upon this disc at a ratio of 12½ to 1. The opening through the seat is 1⅛ in. It may be adjusted to meet any ordinary conditions by adjusting the screws which rest against the metal cage upon which rests a coil spring. When in operation on a heating system the tension of the spring is slight. The American differential pressure relief is 6 in. outside diameter, 10 in. long and weighs 18 lbs. The company also manufactures the American damper regulator for controlling boiler dampers by means of the pressure of water in the heat-

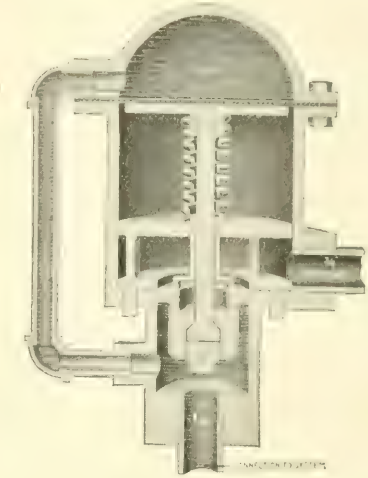


FIG. 2.—AMERICAN DIFFERENTIAL PRESSURE RELIEF.

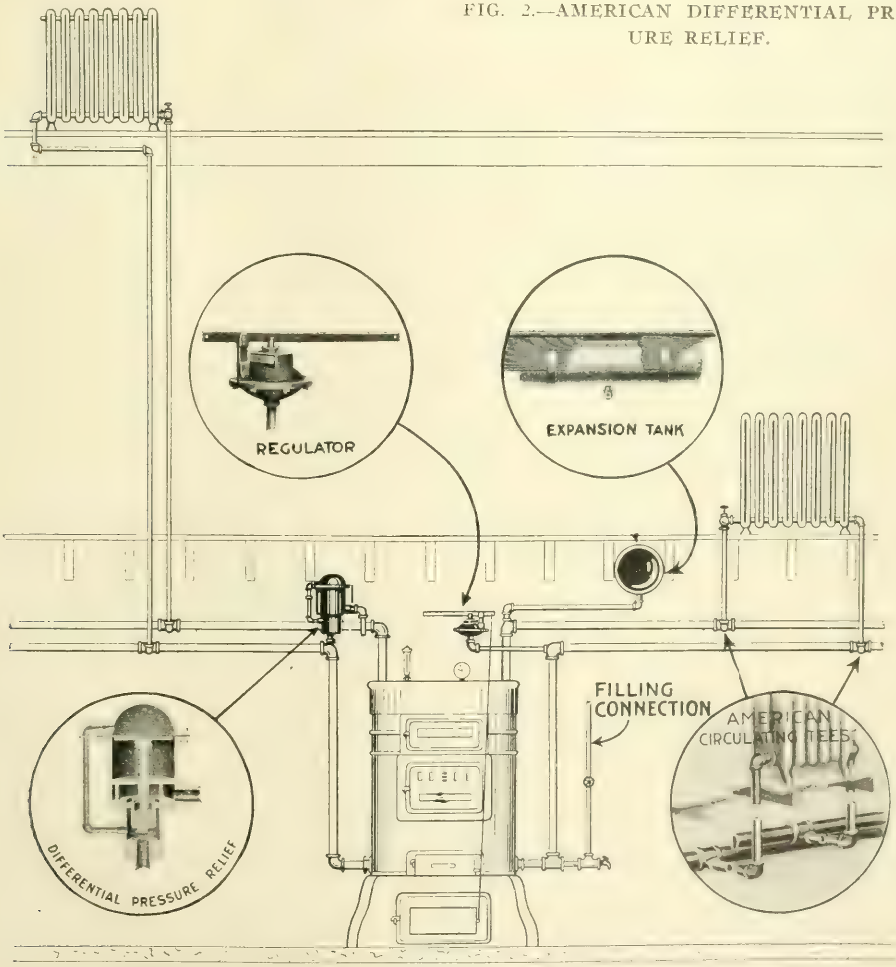


FIG. 1.—AMERICAN HOT WATER HEATING SYSTEM (TANK-IN-BASEMENT METHOD).

ing system. The diaphragm is made of rubber, with canvas insert.

Dr. Hill Dust Counter is brought to the attention of the trade in circular matter recently issued by the Braemer Air Conditioning Corporation, Philadelphia, Pa. Accompanying the circular is a reprint of Dr. Hill's article on "Quantitative Determination of Air Dust" which appeared in The Heating and Ventilating Magazine for June, 1917. The Dr. Hill dust counter has been used by the Chicago Ventilating Division and by the Chicago Commission on Ventilation during the past two years. The patent and manufacturing rights have recently been purchased by the Braemer Air Conditioning Corporation. The apparatus is now on sale at $100.00 list, from which a 40% discount is being allowed at the present time. This company is also sending out a leaflet regarding the U. S. S. Recruit, the land battleship recruiting station in Union Square, New York, which is equipped with a Webster air washer installed by this firm. This apparatus was installed in record time, being delivered within two weeks. The equipment weighs 5,000 lbs. The apparatus was loaned for this purpose by the company and is the same equipment used in the company's laboratory for tests and investigations. A fac simile letter from the Navy Recruitng Station is reproduced expressing the satisfaction of the officers on board with the washer and adding that they found it "unquestionably the most valuable single piece of equipment on board, giving splendid service and at all times keeping the ship supplied with a fresh, clean and pure current of air."

Herr's Humidifier, applicable to all indirect heating systems, including hot air, indirect steam and hot water, is the subject of a circular issued by J. W. McAfee, sole selling agent, 645 West 171st St., New York. This humidifier generates humdity by converting cold water into the atmospheric aqueous vapor by mechanically breaking the water into particles or droplets so fine that the heat at the ordinary temperature of a room, entering these particles of water, breaks them up by expansion into the natural gas or atmospheric vapor.

It is stated that the device will raise the humidity from 16% or 18% to from 50% to 60%, with the air temperature at 68° to 70° F. The nozzle is made from a special bronze, consisting of a valve plug, with a large and small opening to adjust the stream, a set screw for adjustment, a spoon for breaking the small stream of water into a mist and a drip cup for catching the drip. The catalogue includes detail views, one showing the humidifier attached to an indirect radiator. The device will operate with a water pressure from 12 lbs. to 150 lbs. It is listed at $25.00.

Columbian Registers, made by the Columbian Hardware Co., Cleveland, O. are the subject of a comprehensive catalogue (No. 1761) detailing the extensive line made by this company. Included in the company's line are three styles of wall registers, three styles of floor registers and the following specialties: ceiling register and ventilator, base board return air faces, Apex gratings for pipeless furnaces, cast convex base board ventilating plates, Columbian cold-air faces, round registers, wood faces and wall frames. Complete price lists are given for each style. Size 8½ x 11 in. (standard). Pp. 32.

◆

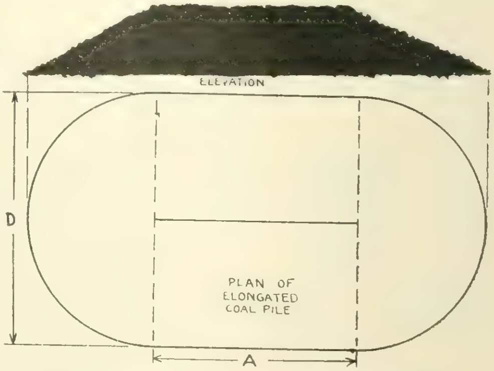
Tons of Coal in Elongated Piles.

By W. F. Schaphorst.

When bituminous coal is piled in a conical pile the tonnage in the volume is easily estimated from the formula, $0.00248\ D^3$, where D is the diameter of the pile in feet at its base. But coal is often stored in elongated piles, as shown in the accompanying sketch, in which case the tonnage, of bituminous coal, is computed from the formula:

$$0.00248\ D^3 + 0.00474\ AD^2 = \text{tons (bituminous)}.$$

where A is the length of the "crest" on the pile in feet. The best way to determine the



SKETCH OF ELONGATED COAL PILE.

length of this crest is to subtract D from the total length of the pile at its base.

The sketch shows one of these piles both in elevation and in plan. The plan shows clearly how the pile can be cut up into three parts. The two curved end portions, when added together, give us a pure and simple cone, whence we have the $0.00248\ D^3$ in the formula. The central portion has a triangular section from end to end and its volume is one-half as great as would be the volume of a rectangular block having the same base and height. The tonnage in this central triangular portion is $0.00474\ AD^2$. Adding the two together we therefore have $0.00248\ D^3 + 0.00474\ AD^2$.

Where the coal is anthracite instead of bituminous the formula becomes

$$0.00172\ D^3 + 0.0033\ AD^2 = \text{tons anthracite.}$$

D and A are both measured in feet.

These formulas are based on the fact that one ton of coal occupies 38 cu. ft. on the average, whether anthracite or bituminous. The natural cone of anthracite is 0.25 as high as it is in diameter at its base. For bituminous coal the value is 0.36.

◆

Establishment of New Industries To Be Limited During the War.

The Council of National Defense has recommended that no new industrial enterprise should be undertaken at this time which will not help win the war. "In the course of time," says Mr. Waddill Catchings, speaking as chairman of a subcommittee of the council, representing the Chamber of Commerce of the United States, "no one need be surprised if during the war the use of labor and materials for all unessential purposes is made impossible by regulation or statute."

Following is the recommendation in full as made by the Council of National Defense:

"Every effort that this country is capable of making should be applied to bring the war to a speedy and successful conclusion. The resources of the country in a general way may be said to consist of men, money and material, and during the period of the war any new enterprise or undertaking should be tried and justified by the test: Will the men, money and material so applied best contribute in this way to the winning of the war?

"New enterprises which are not fundamental to the efficient operation of the country's necessary activities should not be undertaken. This will not result adversely upon business or conditions of employment because every man and every resource will be needed during the war. All effort should be centered to help win the war."

◆

Call for Technical Troops for France.

"Handy Men" between the ages of 18 and 40 are being called for by the United States Corps of Engineers and by the Aviation Section, Signal Corps. For the Engineers' Corps not only skilled engineers are wanted, but also helpers and workers, clerks, watchmen, etc., in such occupations as water supply companies, pioneer companies, surveying and mapping, railway construction, railway operating, supply and shop work, road building, construction, mining and quarrying. For the aviation section many aero battalions are being organized to comprise both skilled mechanics and helpers, clerks, watchmen, etc., in a wide variety of occupations, including draftsmen, electricians, engine repair men, engine testers, plumbers, stenographers and tool makers. Recruiting stations for both of these services are established at 266 Market St., Newark, N. J., and at the following cities in New Jersey: Paterson, New Brunswick, Camden, Atlantc City, Passaic, Elizabeth, Trenton and Perth Amboy. Major J. E. Bloom, U. S. A. Retired, is in charge.

◆

Deaths

Sam S. Glauber, president and treasurer of S. S. Glauber, Inc., New York, jobbers of heating and plumbing supplies, died suddenly in Denver, Colo., September 15. He was 42 years old. Mr. Glauber had long been in ill health. He had been connected with the Eastern supply trade since 1895.

Andrew C. Mercer, designer of the Mercer heating boiler, died at his home in Brooklyn, September 30. He was 81 years old. Mr. Mercer was a contemporary of the pioneers of the heating profession in this country. He was for many years manager of the New York office of the H. B. Smith Co., of Westfield, Mass. This firm placed the Mercer boiler on the market and has continued to manufacture it up to the present time. Mr. Mercer is survived by one son.

Standard Heating and Ventilating Data Sheets.

Previously-published data sheets, similar to those appearing in this issue, are as follows:

February, 1917, Issue.

No. 1—B.T.U. Losses.
No. 1-A—B.T.U. Losses—Brick.
No. 1-B—B.T.U. Losses—Stone and Concrete.
No. 1-C—B.T.U. Losses—Combinations

March, 1917, Issue.

No. 1-D—B.T.U. Losses—Tile.
No. 1-E—B.T.U. Losses—Frame Construction.
No. 1-F—B.T.U. Losses—Glass, Skylight and Miscellaneous.
No. 1-G—B.T.U. Losses—Ceiling, Floor and Roof.

April, 1917, Issue.

No. 2—Exposure.
No. 3—Leakage.
No. 4—Temperature Range.
No. 4-A—Temperature Range.

May, 1917, Issue.

No. 5—Computing Heat Losses.
No. 6—B.T.U. Example of Computation.
No. 7—Ventilation.
No. 8—Air Changes—Churches and Theatres.

June, 1917, Issue.

No. 8-A—Air Changes—Hospitals.
No. 8-B—Air Changes—Hotels and Libraries.
No. 8-C—Air Changes—Schools.
No. 8-D—Air Change—Miscellaneous.

July, 1917, Issue.

No. 9—Properties of Air.
No. 10—Ducts and Flues.
No. 10-A—Elbows.
No. 10-B—Anemometer Readings.

August, 1917, Issue.

No. 10-C—Underwriters' Rules.
No. 10-D—Underwriters' Rules (Continued).
No. 10-E—Underwriters' Rules (Continued).
No. 10-F—Duct and Flue Velocities.

September, 1917, Issue.

No. 10-G—Vent Flue Velocities.
No. 10-H—Areas of Pipes.
No. 10-I—Areas of Pipes. (Continued).
No. 10-J—Pipe Capacities at Various Velocities.

October, 1917, Issue.

No. 100—Chimneys.
No. 100-A—Chimneys—Residence.
No. 100-B—Chimneys—Residence (Continued).
No. 100-C—Chimneys—Coal and Air per B.H.P.

Errata.

Sheet No. 8-A, in the June issue on "Air Changes—Hotels and Libraries," should be No. 8-B.

Sheets Nos. 10-J and 10-K on "Area of Pipes," should be Nos. 10-H and 10-I.

In Sheet No. 9, on "Properties of Air," an error appears in the last column heading which should read, "Cubic Feet of Air Raised 1° F. by 1 B.T.U."

All of these errors have been corrected on the reprinted loose sheets.

Copies of the Standard Heating and Ventilating Data Sheets, printed separately on one side only, may be obtained at 5 cents each. Special binders are furnished by the Heating and Ventilating Magazine Company for holding the sheets, the price of the binders being $1.00 postpaid. They are bound in brown duck, with strong spring clasp.

Special attention is called to the fact that the sheets will not always appear in these columns consecutively numbered.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, OF THE HEATING AND VENTILATING MAGAZINE, **published monthly at Cooperstown, N. Y., for October 1, 1917.**

County of New York, } ss.
State of New York, }

Before me, a notary in and for the State aforesaid, personally appeared A. S. Armagnac, who, having been duly sworn, according to law, deposes and says that he is the Editor of The Heating and Ventilating Magazine, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912 embodied in Section 443 Postal Laws and Regulations printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Heating and Ventilating Magazine Co., 1123 Broadway, New York.
Editor, A.S. Armagnac, 1123 Broadwy, New York.
Managing Editor, None.
Business Manager, Gustave Petersen, 1123 Broadway, New York.

2. That the owners are: (Give names and addresses of individual owners, or if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)

Heating and Ventilating Magazine Co., 1123 Broadway, New York.
A. S. Armagnac, 1123 Broadway, New York.
Gustave Petersen, 1123 Broadway, New York.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner and this affiant has no reason to believe that any other person, association or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

A. S. ARMAGNAC, Editor.

Sworn to and subscribed before me this 27th day of September, 1917.
A. L. Scantlebury, No. 239,
Notary Public, Kings County,
Certificate filed in New York County.
(My commission expires March 30, 1919.)

Chimneys

The next factor consists of determining the draft loss through the fire, this loss varying according to the number of pounds of coal burned per square foot of grate and the quality of coal used.

Tests show that under average conditions the loss of draft through the fire runs about as follows:

DRAFT LOSS IN FIRE.

(In. of water)

	POUNDS OF COAL PER SQUARE FOOT PER HOUR BURNED ON GRATES								
FUEL	5	10	15	20	25	30	35	40	45
Anthracite									
No. 3 Buck	0.15	0.40	0.75	1.24	..	..	..	..	..
No. 1 Buck	0.10	0.24	0.44	0.68	1.00	..	..	..	..
Pea	0.06	0.16	0.30	0.45	0.65	0.90	1.20	..	..
Bituminous									
Semi bituminous	0.05	0.10	0.18	0.26	0.35	0.45	0.58	0.70	0.78
Penn. Ala. Ill. & Ind.	0.04	0.09	0.15	0.22	0.28	0.38	0.45	0.55	0.60
Slack	0.04	0.07	0.10	0.15	0.20	0.27	0.34	0.40	0.50
Run of Mine	0.04	0.05	0.08	0.10	0.14	0.16	0.20	0.25	0.32
On Chain Grate	0.05	0.12	0.15	0.23	0.31	0.44	0.57	0.75	0.94

For ordinary installations the burning of 5 lbs. of coal per horsepower is usually assumed. The maximum number of pounds of coal which a boiler must consume divided by the grate area in square feet will give the number of pounds of coal burned per square foot of grate.

The draft losses in boilers run about as follows:

Type of Boiler.	Per cent of Nominal Rating Developed		
	100	150	200
	Loss in Inches of Water		
Water Tube	0.25	0.40	0.70
H. R. T.	0.20	0.30	0.45
Vertical	0.10	0.15	0.20

As heating boilers are seldom run at any overload, 0.25 or 0.30 may be taken as covering the draft loss in any such boiler.

Economizers add 0.30 in. to the draft loss.

Draft losses for bends and smoke breeching are:

Steel Flues per 100 ft. run, 0.10 in.; for each 90° bend, 0.05 in.

Concrete per 100 ft. run, 0.20 in.; for each 90° bend, 0.10 in.

Note.—Include every bend from the boiler uptake to the stack, counting the turn upward in the stack as one bend.

CHIMNEYS—DRAFT LOSS IN FIRE AND BOILER **NO. 100-D**

Chimneys

The draft loss in the stack should run about 0.20 in. per 100 ft. of height in order to get economical construction.

The "effective" draft is the theoretical draft produced by the stack, with gases at a given temperature, less the loss produced by friction. The theoretical draft is shown by the curves in Sheet No. 100-F.

Air at higher elevation than sea level expands and requires a chimney of larger area to handle the same number of pounds at the same velocity and friction loss. The table below gives the percentage of increase for various heights up to 10,000 ft. above sea level.

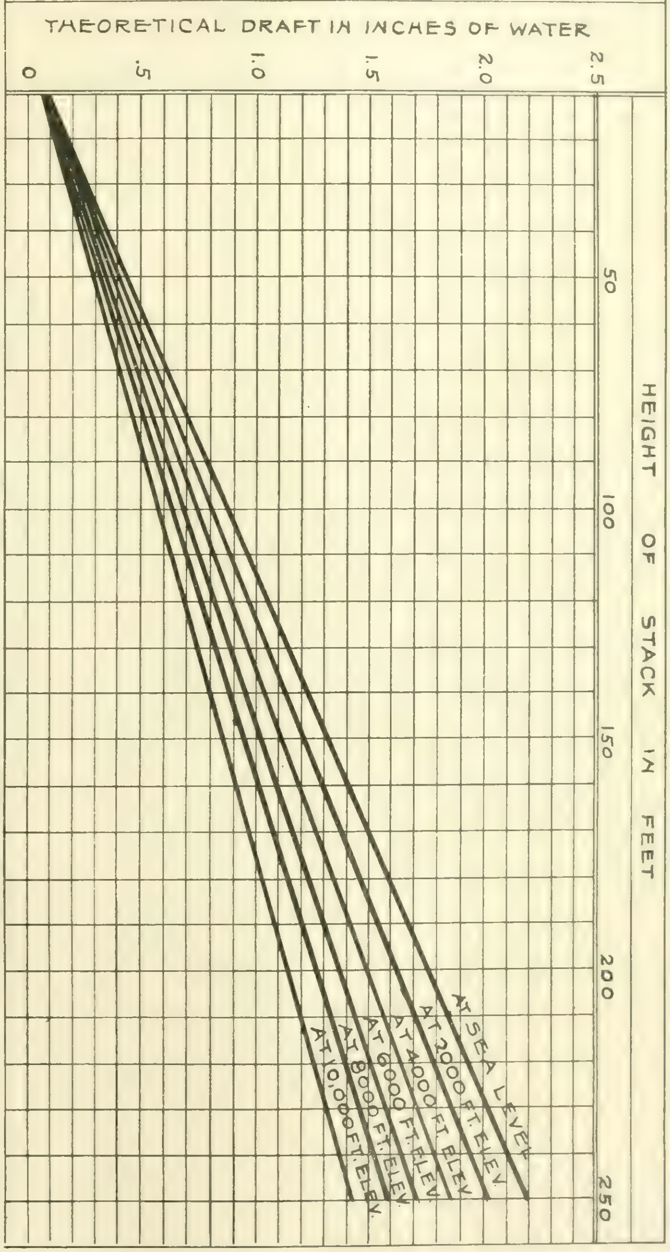
FACTORS OF AIR AT VARIOUS ELEVATIONS.

Elevations Above Sea Level Feet	Air Pressure Per Sq. in. in Pounds	Cubic Feet Per Lb.	Increase In Volume %
0	14.7	13.33	0.000
1,000	14.2	13.80	0.034
2,000	13.7	14.31	0.073
3,000	13.2	14.84	0.113
4,000	12.7	15.43	0.158
5,000	12.2	16.07	0.203
6,000	11.7	16.75	0.257
8,000	10.7	18.31	0.373
10,000	9.7	20.20	0.514

FORMULA: $D = .52 \times H \times P\left(\frac{1}{T} - \frac{1}{t}\right)$ WHEN "D" IS THEO. DRAFT, "H" HEIGHT OF STACK, "P" AIR PRESSURE IN LBS., "T" AB. OUTSIDE TEMP, & "t" AB. STACK TEM.

THEORETICAL DRAFT OF STACKS

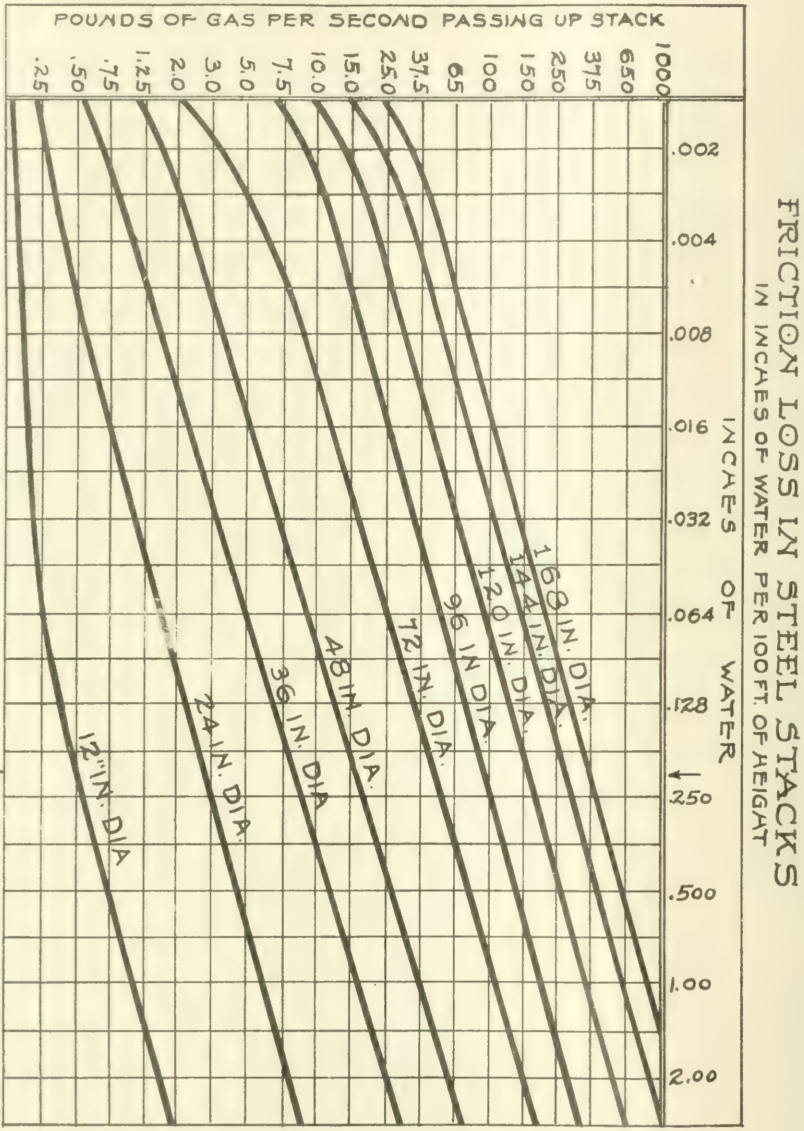
WITH OUTSIDE TEMP ZERO, STACK TEMP. 500°F



NOTE. THEORETICAL DRAFT NEGLECTS ALL FRICTION AND MUST EQUAL OR EXCEED ALL DRAFT LOSSES BY FRICTION INCLUDING LOSSES IN STACK ITSELF, BOILER BREECHING, ELBOWS, BOILER FLUES, FIRE BED AND GRATES AND ECONOMIZER (IF USED).

THE HEATING AND VENTILATING MAGAZINE – 1123 BROADWAY – N. Y. CITY.

NOTE... STEEL STACKS WITH BRICK LINING HAVE → SAME LOSS AS BRICK CHIMNEYS.



FOR ANY OTHER HEIGHT (H) OF STACK MULTIPLY TABLE LOSS BY $\frac{H}{100}$

FORMULA: $CF = G^2 \times .0014 \times H \times C \div A^3$ WHEN "CF" IS CHIMNEY FRICTION IN INCHES OF WATER, "G" THE WEIGHT OF GAS PER SECOND, "H" THE HEIGHT OF STACK, "C" CIRCUMFERENCE & "A" AREA ALL IN FEET AND .0014 A CONSTANT FOR STEEL STACKS & GASES AT 500° F.

CHIMNEYS—FRICTION LOSSES IN STEEL STACKS | No. 100-G

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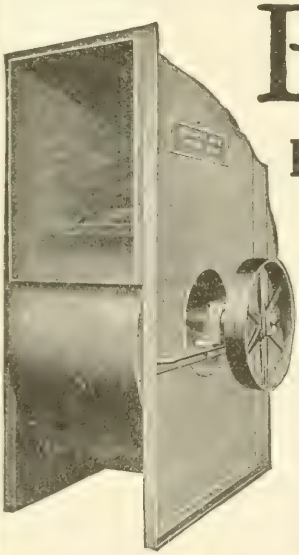

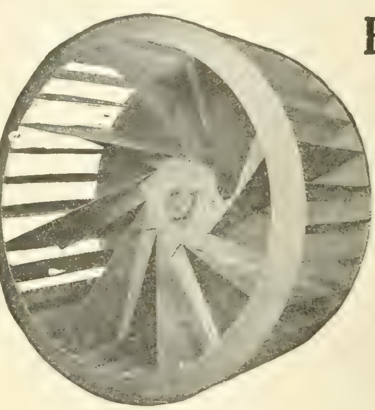

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THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. DECEMBER, 1917 1123 Broadway, New York

Calibration of Anemometers

By A. H. ANDERSON

The data given in this article will show that the method of calibrating anemometers by swinging in a short radius is quite erroneous.

The apparatus shown in Fig. 1 indicates the manner of mounting the anemometer on an arm 18 in. long. The trigger of the anemometer is connected to the bent lever at the center of rotation by which means the counting mechanism may be engaged or disconnected.

Fig. 2 shows the anemometer mounted at the end of an arm 23½ ft. long. One end of the arm is centered on the post of a heavy iron tripod. The other end is supported by a rubber-tired wheel 10 in. in diameter. The trigger is operated by two cords A and B which are loosely supported by two rings near the center of rotation.

Cord A slips over the pulley C and thence to the trigger while cord B runs to the trigger direct. The operator stands near the tripod and by means of the cords the counting mechanism of the anemometer is engaged or disengaged while the arm is in rotation. Such a test as this must be conducted in a large room with a very smooth floor, and it is also necessary that the air in the room be undisturbed by drafts. It is possible to rotate the arm at any rate from exceedingly slow to 1000 ft. per minute. The method of making a test is to make a mark on the floor and start the arm around its path at as nearly the right speed as can be judged by eye, the counting mechanism of the anemometer being disengaged, and at the instant the wheel passes the mark on the floor

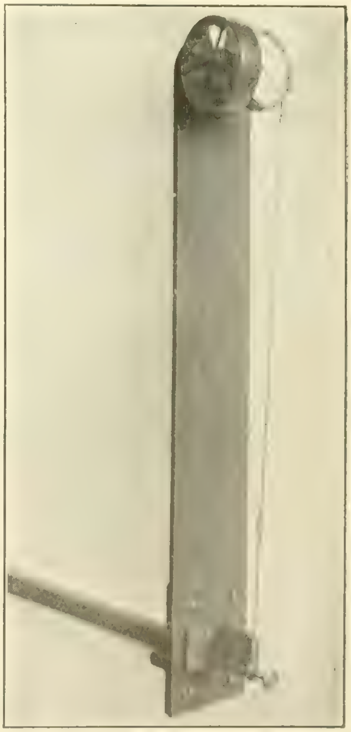


FIG. 1—METHOD OF MOUNTING ANEMOMETER ON ARM 18 IN. LONG.

the time is noted and the cord for engaging the anemometer is pulled. One or two complete revolutions by the arm should be made at a uniform speed, the counting mechanism of the anemometer being disengaged when the wheel again passes the starting mark on the floor, and the time noted at the same instant. The circumference of the circle described by the center of the anemometer is 147.7 ft., and it will be found the anemometer indicates a little more or less than that amount. Similar runs are made at different rates of rotation.

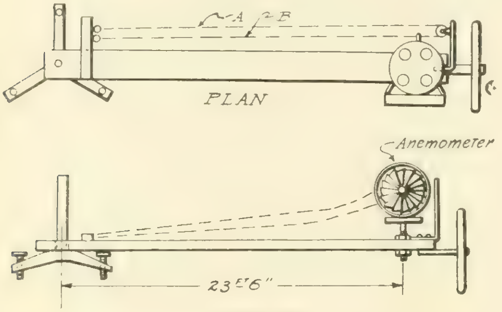


FIG. 2 ANEMOMETER MOUNTED ON ARM 23½ FT. LONG.

At speeds greater than 1,000 ft. per minute the rotation of the long arm becomes too rapid for convenient manipulation, and the anemometer is now dismounted from the arm and the calibration continued by means of the pitot tube. A blast of air is provided from a centrifugal fan through a round pipe 24 in. diameter (see Fig. 3). The anemometer is mounted in the blast at the outlet of the pipe and close beside it is mounted a pitot tube which is connected by rubber tubing to a sensitive gauge reading in inches of water. The blast of air can be varied by changing the speed of the fan and beginning with an air velocity of 1,000 ft. per minute the reading of the anemometer is noted for the period of a minute and the indication of the differential gauge is read.

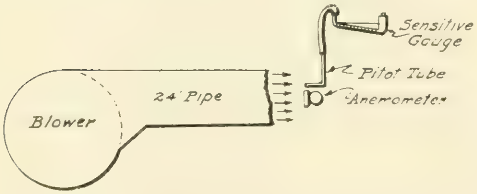


FIG. 3—ARRANGEMENT OF AIR BLAST WITH LOCATION OF PITOT TUBE AND ANEMOMETER.

Similar runs are made at suitable intervals up to 4,000 ft. per minute. The following table gives the velocities in feet per minute corresponding to various pitot tube velocity heads. The velocities obtained from the pitot tube indications are the correct velocities.

TABLE 1.

Temperature of Air 80° F.

Velocity Pressure Inches	Feet per Minute	Velocity Pressure Inches	Feet per Minute
0.01	409	0.96	4008
0.02	579	0.97	4029
0.03	710	0.98	4050
0.04	818	0.99	4070
0.05	914	1.00	4090
0.06	1000	1.01	4110
0.07	1080	1.02	4130
0.08	1155	1.03	4150
0.09	1227	1.04	4170
0.10	1295	1.05	4190
0.11	1355	1.06	4210
0.12	1418	1.07	4230
0.13	1475	1.08	4250
0.14	1530	1.09	4270
0.15	1585	1.10	4290
0.16	1635	1.11	4308
0.17	1690	1.12	4327
0.18	1735	1.13	4345
0.19	1785	1.14	4364
0.20	1830	1.15	4382
0.21	1875	1.16	4401
0.22	1920	1.17	4419
0.23	1960	1.18	4438
0.24	2005	1.19	4456
0.25	2050	1.20	4475
0.26	2090	1.21	4493
0.27	2125	1.22	4512
0.28	2160	1.23	4530
0.29	2200	1.24	4549
0.30	2240	1.25	4567
0.31	2275	1.26	4586
0.32	2310	1.27	4604
0.33	2350	1.28	4623
0.34	2390	1.29	4641
0.35	2420	1.30	4660
0.36	2455	1.31	4678
0.37	2485	1.32	4696
0.38	2520	1.33	4714
0.39	2550	1.34	4732
0.40	2590	1.35	4750
0.41	2620	1.36	4768
0.42	2650	1.37	4786
0.43	2680	1.38	4804
0.44	2710	1.39	4822
0.45	2740	1.40	4840
0.46	2770	1.41	4857
0.47	2800	1.42	4874
0.48	2830	1.43	4891
0.49	2865	1.44	4908
0.50	2890	1.45	4925
0.51	2920	1.46	4942
0.52	2950	1.47	4959
0.53	2980	1.48	4976
0.54	3000	1.49	4993
0.55	3030	1.50	5010
0.56	3060	1.60	5180
0.57	3090	1.70	5330
0.58	3115	1.80	5490
0.59	3140	1.90	5640
0.60	3170	2.00	5790
0.61	3200	2.10	5930

0.62	3225	2.20	6080
0.63	3250	2.30	6210
0.64	3275	2.40	6330
0.65	3300	2.50	6480
0.66	3325	2.60	6600
0.67	3350	2.70	6720
0.68	3375	2.80	6850
0.69	3400	2.90	6970
0.70	3425	3.00	7090
0.71	3450	3.10	7200
0.72	3475	3.20	7320
0.73	3500	3.30	7430
0.74	3525	3.40	7540
0.75	3550	3.50	7660
0.76	3570	3.60	7760
0.77	3590	3.70	7870
0.78	3615	3.80	7970
0.79	3640	3.90	8070
0.80	3660	4.00	8180
0.81	3680	4.10	8280
0.82	3700	4.20	8400
0.83	3720	4.30	8480
0.84	3740	4.40	8580
0.85	3765	4.50	8670
0.86	3790	4.60	8770
0.87	3810	4.70	8870
0.88	3835	4.80	8970
0.89	3860	4.90	9055
0.90	3880	5.00	9140
0.91	3905	5.10	9225
0.92	3925	5.20	9310
0.93	3946	5.30	9395
0.94	3967	5.40	9480
0.95	3988		

TABLE 2

If temperature is other than 80° F. multiply velocities in Table 1 by constants corresponding to various temperatures:

50° F.	0.972
60° F.	0.980
70° F.	0.990
80° F.	1.000
90° F.	1.010
100° F.	1.025
110° F.	1.038

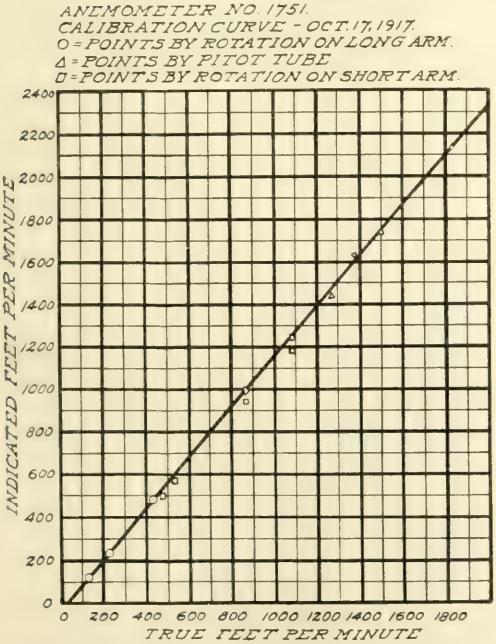


FIG. 4—RELATION BETWEEN TRUE VELOCITIES AND INDICATED VELOCITIES OF ANEMOMETER.

Fig. 4 shows the relation between the true velocities and the indicated velocities of the anemometer. The points in the test made with the long arm are indicated by small circles, which the points obtained by pitot tube are shown by crosses. The points obtained by the short arm are shown by small squares and it will be seen that there is a discrepancy between the short arm and the long arm results. The indications obtained by moving the anemometer in a straight line, and it is to be expected that the short arm would give indications which are slower than with the long arm for equal peripheral velocities.

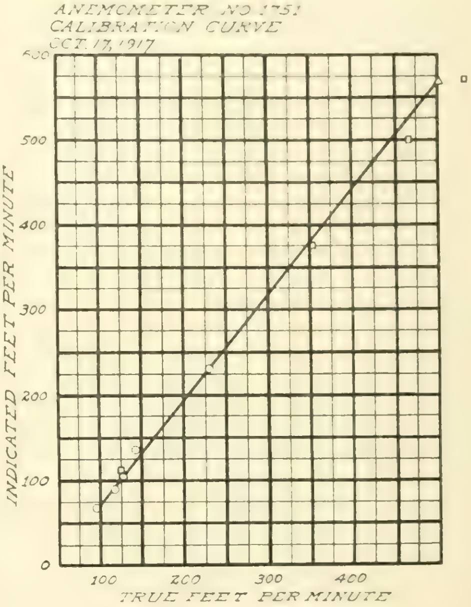


FIG. 5.

From the calibration test the following table of corrections may be drawn up:

Table 3

Anemometer Indication	Add or Subtract
50	+ 40
100	+ 25
150	+ 10
200	+ 5
250	— 5
300	— 15
350	— 25
400	— 35
450	— 40
500	— 50
600	— 70
800	— 100
1000	— 130
1200	— 160
1400	— 190
1600	— 220
1800	— 250
2000	— 280

Fig. 5 is the part of the curve from 0 to 500 ft. per minute drawn to a large scale.

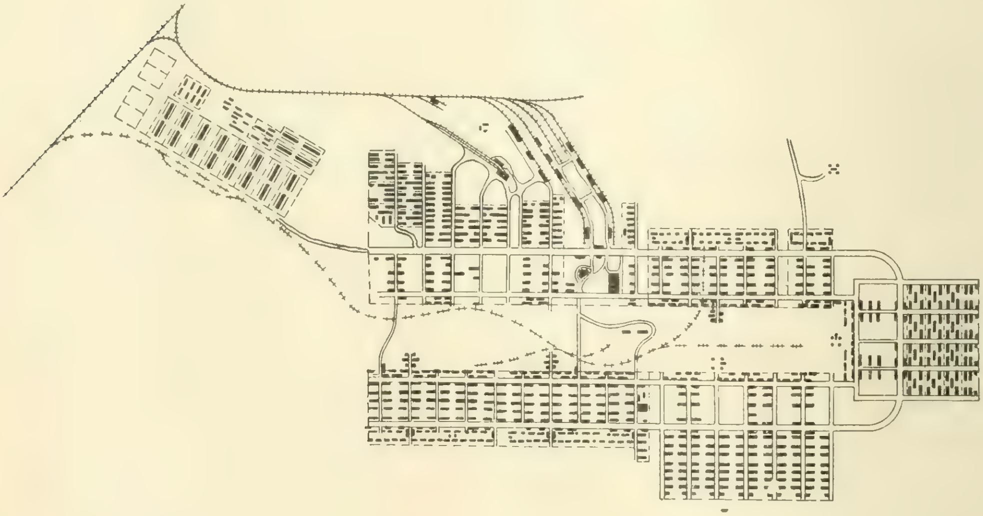
The Heating Equipment for a Great Military Camp

Details of the Installation at a Typical Cantonment — Camp Upton, Yaphank, L. I.

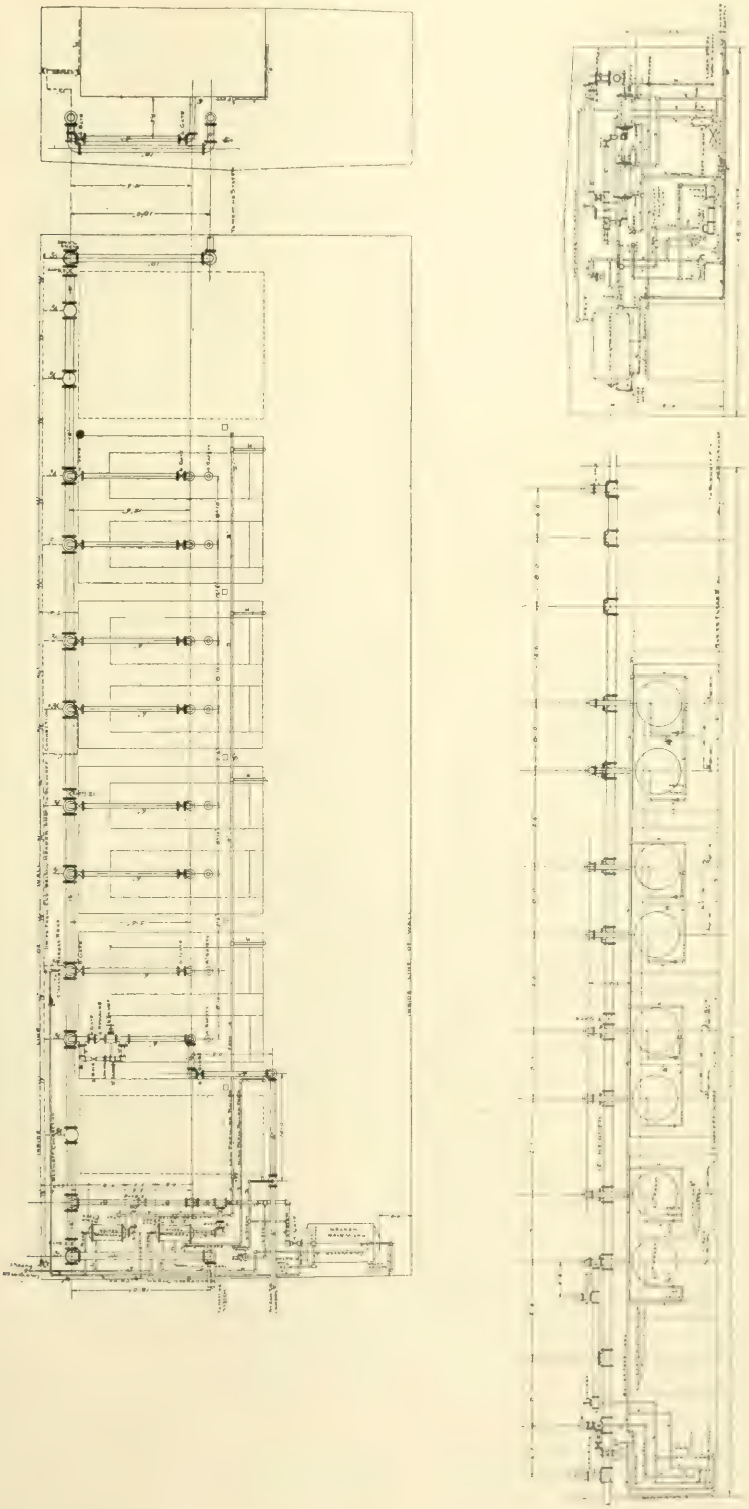
No one who has not visited one of the great army cantonments that have been constructed for the new United States National Army can have any adequate conception of the extent of these camps or of the masses of materials that had to be furnished for their construction and equipment—in many cases on short notice and in spite of serious obstacles. It will always remain a tribute to American efficiency that the camps were sufficiently advanced in construction to permit the drafted men to report on the date scheduled and to march into their quarters. To the public generally, and especially to engineers, the development of the plans and the design of the equipment have been matters of lively interest, but, due at first to the naturally reticent policy of the government and, later, to the overwhelming rush of work in completing the cantonments on time, it has not been possible until now to present a full description of the camps.

UNIFORM GENERAL PLAN FOR ALL CANTONMENTS.

Although the equipment of the various cantonments differs in many respects, in all basic features the arrangements are the same. The basic plans for the heating of all the cantonments were prepared in Washington under the direction of General I. W. Littell, constructing quartermaster, Major Gunby having charge of the engineering features and Captain Tripp having charge



GENERAL PLAN OF CAMP UPTON, YAPHANK, L. I., N. Y.
(1200 Acres Are Included Within the Cantonment Limits.)



BASE HOSPITAL BOILER HOUSE, CAMP UPTON.

of the heating, under Major Gunby's direction. For the most part variations were made from these plans only where local conditions made it necessary.

At Camp Upton, located at Yaphank, L. I., New York, the entire construction work was under the direction of Major O. K. Myers, constructing quartermaster. The contract for the construction and equipment was awarded to the Thompson-Starrett Company, William H. Driscoll, of that company, having direct charge of the water supply, plumbing and electrical work. Walter S. Timmis, of New York, was retained as consulting engineer for the heating.

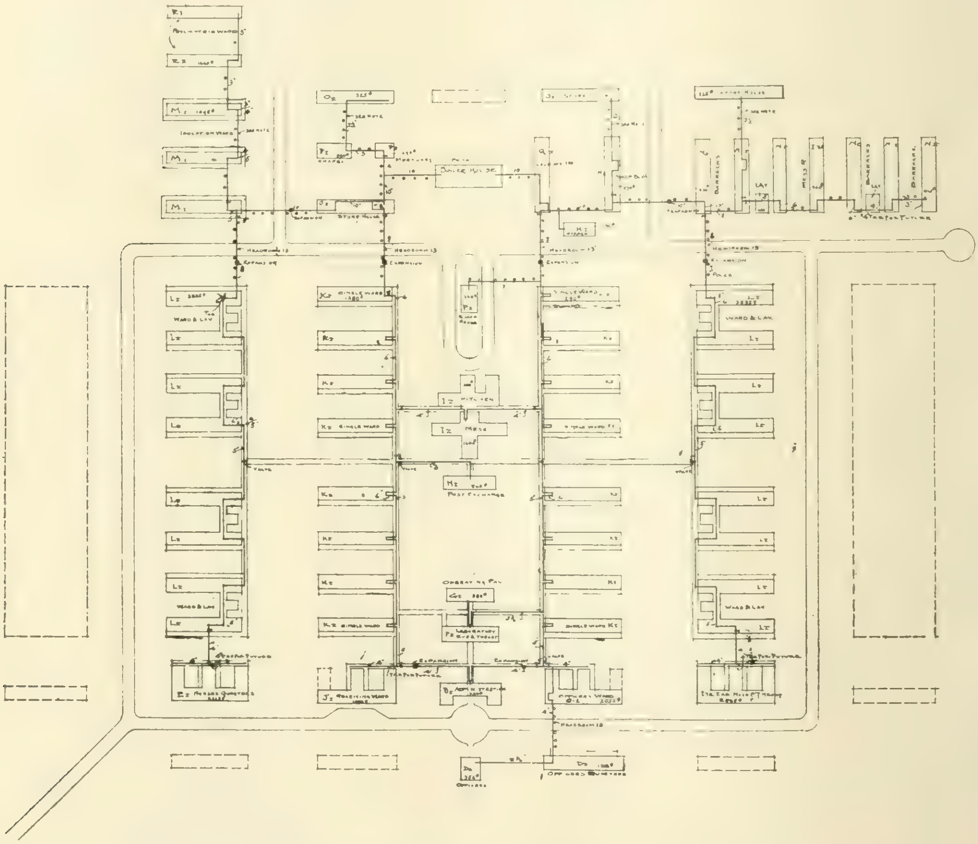
For the present, at least, all of the barracks are heated by room heaters and stoves. There is, however, a great number of buildings which are supplied with steam heat. The following list, showing the buildings heated by steam and those heated by stoves, will give some indication of the vastness of the camp:

BUILDINGS STEAM HEATED

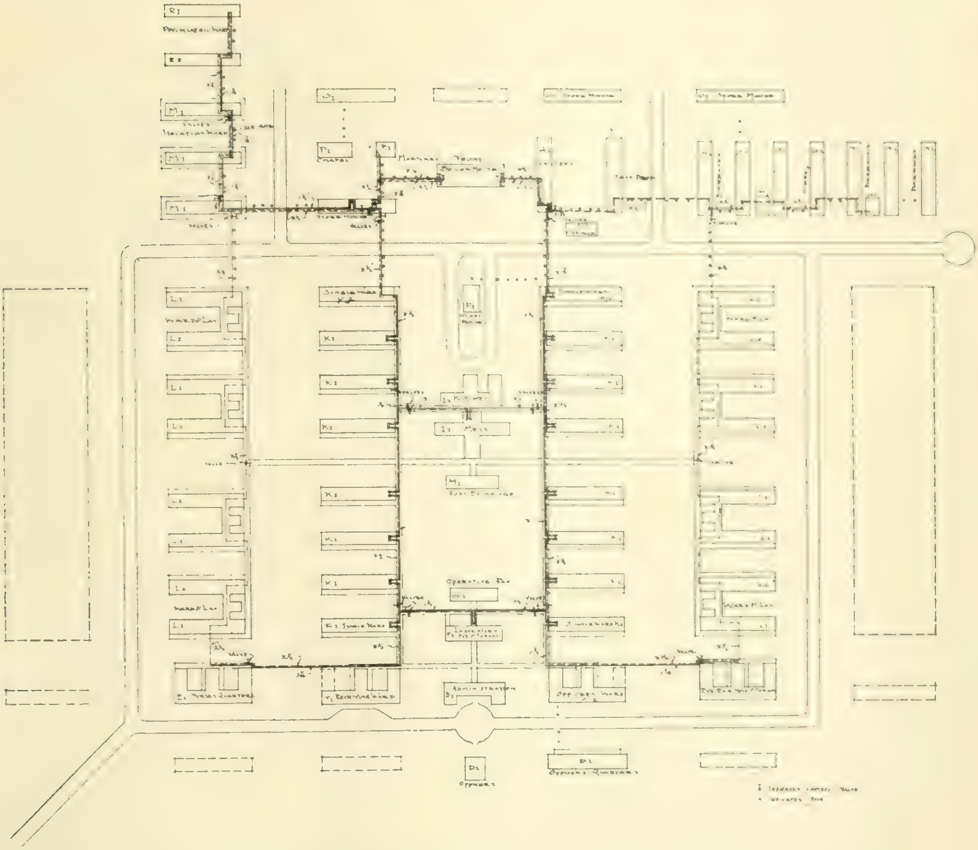
108	Officers quarters
12	Medical Buildings
2	Fire Houses
1	Bakery
1	Laundry
2	Residences
2	Administration Bldgs.
60	Hospital Buildings

BUILDINGS HEATED BY STOVES

255	Lavatories
359	Barracks
40	Guardhouses



LAYOUT OF STEAM HEATING MAINS, BASE AND CANTONMENT HOSPITAL, CAMP UPTON.



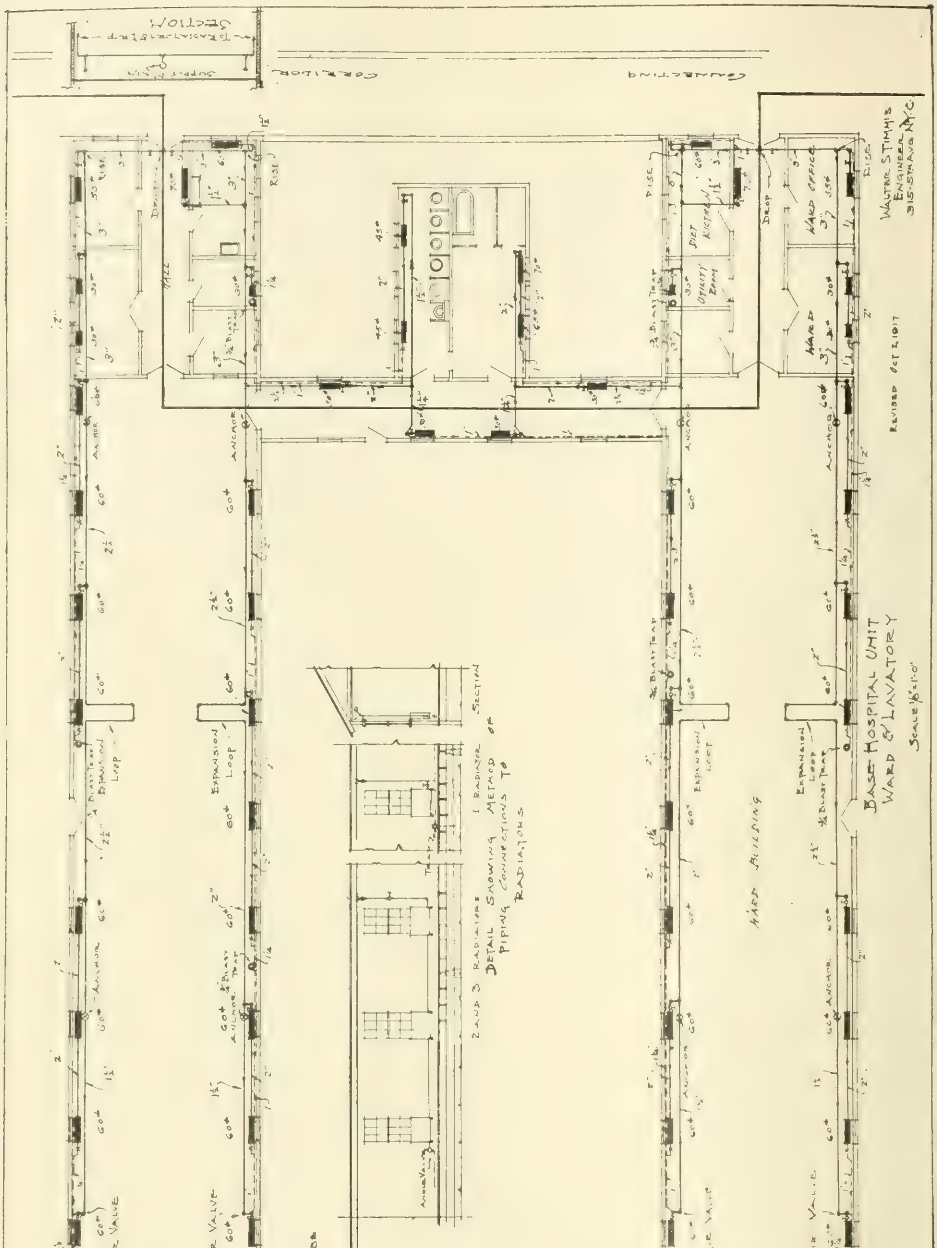
LAYOUT OF LIVE STEAM MAINS AND HOT WATER PIPING, BASE AND CANTONMENT HOSPITAL, CAMP UPTON

12 Post Exchanges
17 Administration buildings
1 Post Office
1 Telephone & Telegraph office
23 Mess buildings
3 Offices
4 Operating Rooms
2 Warehouses
4 Utility buildings
40 Barracks for Civilians

THE HOSPITAL GROUP.

Included in the hospital group are sixty buildings occupying a space of about 100 acres. These buildings are all heated from a central heating station, equipped with eight 150-H.P. boilers, with provision for three additional boilers of the same size. Direct radiation is used throughout in the form of two- and three-column cast-iron radiators. Every effort was made to simplify the installation of the system and the illustrations show a simple expedient used so that the returns could be carried underneath the radiators. Stands for the radiators were made of uniform type and in great numbers. These stands are simple wooden frames from 8 to 10 in. high and were found very serviceable.

The returns from the radiators are trapped and run to dry wells outside the various buildings. The distributing piping is carried overhead and for the most part in corridors which are enclosed and which connect the various buildings. Where the distributing piping is exposed to the weather some protection is afforded by a covering of 1-in. air cell, over which is placed a layer of 1-in.



BASE HOSPITAL UNIT, CAMP UPTON, SHOWING METHOD OF PIPING CONNECTIONS TO RADIATORS.

hair felt, the whole being enclosed in water-proof roofing paper, bound on with twine. Here again the time factor was paramount, making it out of the question to lay the piping underground. Provision is made for expansion by the use of expansion loops and expansion joints, the loops being adopted wherever possible. These are shown in the single and double wards on the group plan of the base and cantonment hospital units.

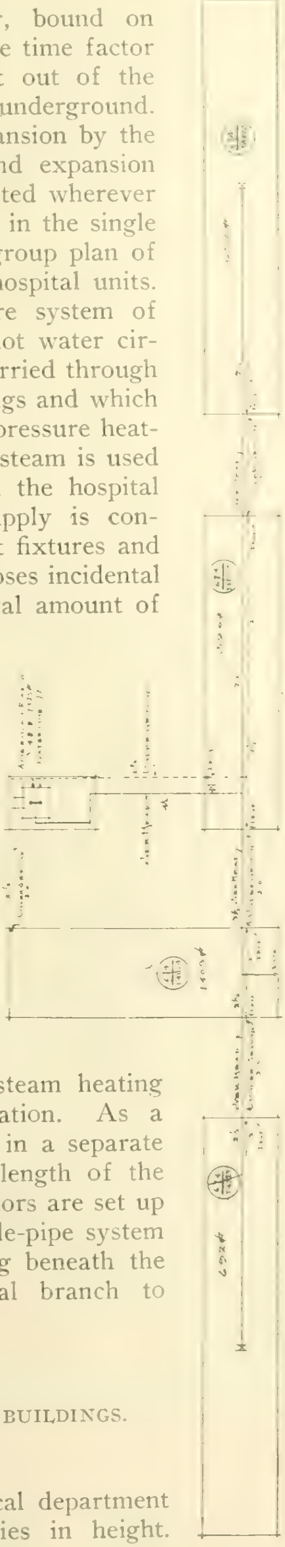
There is a high-pressure system of steam distribution and a hot water circulating system which is carried through most of the hospital buildings and which runs parallel with the low-pressure heating mains. High-pressure steam is used for sterilizing purposes in the hospital group; the hot water supply is connected to the various toilet fixtures and is also used for other purposes incidental to hospital work. The total amount of radiation in the hospital group is approximately 90,000 sq. ft.

OFFICERS QUARTERS.

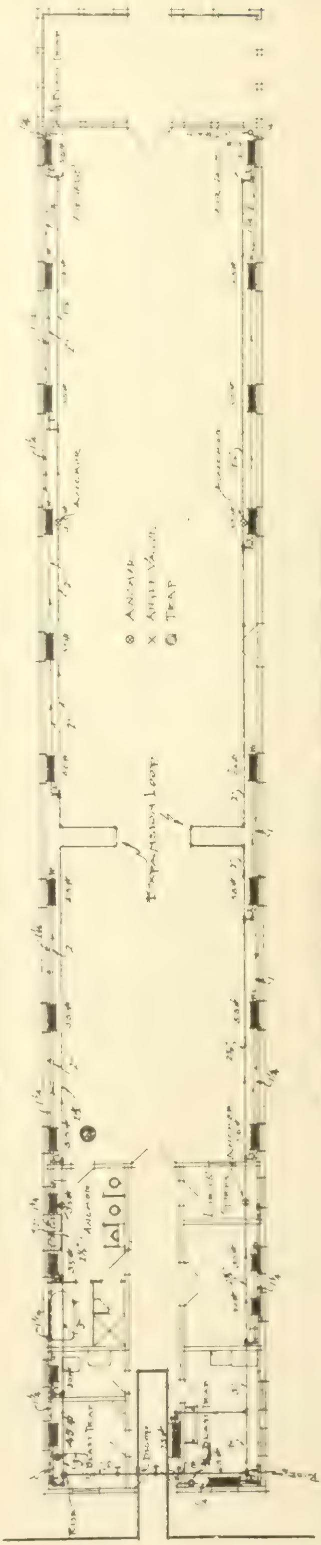
Approximately 108 buildings used as officers' quarters are scattered through the camp. These buildings range in size from 20 ft. × 70 ft. 6 in. to 20 ft. × 133 ft. Each building is heated by a separate steam heating system, with direct radiation. As a rule, the boiler is located in a separate building, midway of the length of the main building. The radiators are set up from the floor and a single-pipe system installed, the pipe running beneath the radiators, with a vertical branch to each radiator.

MEDICAL DEPARTMENT BUILDINGS.

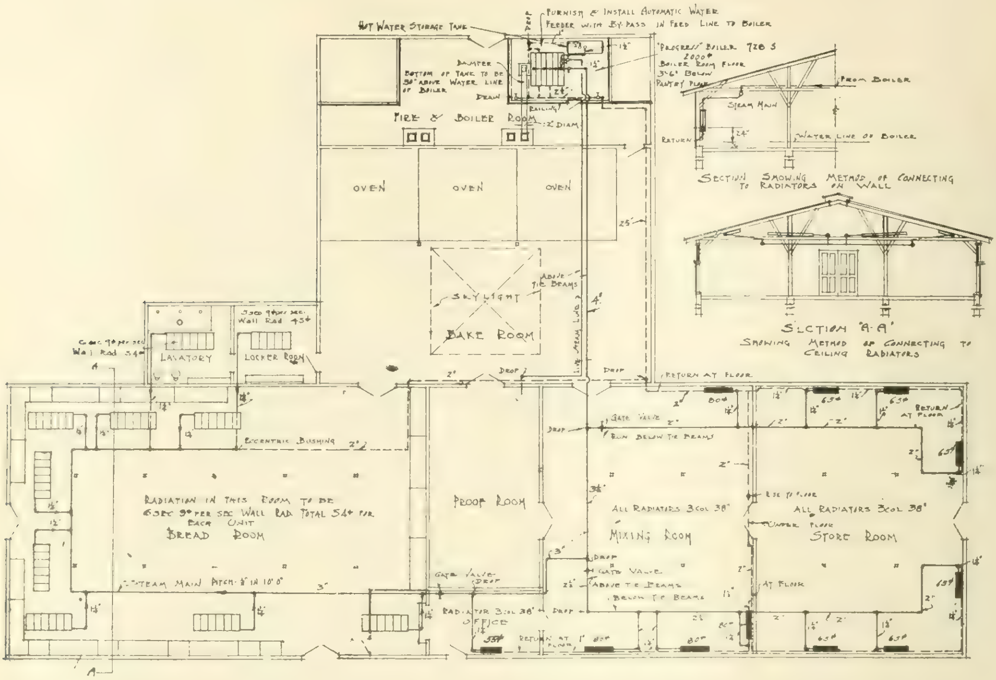
There are fifteen medical department buildings, each two stories in height.



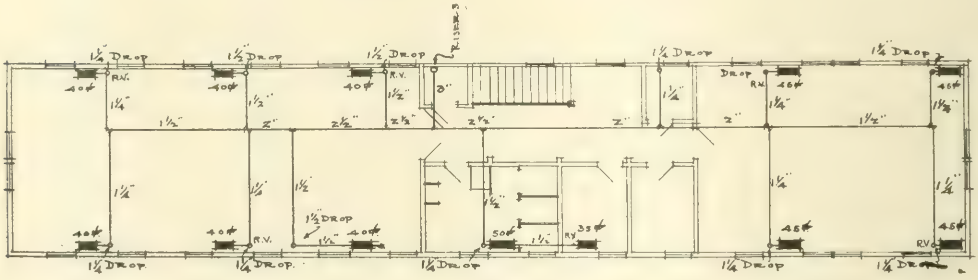
DIVISION HEADQUARTERS BUILDINGS, CAMP UPTON, SHOWING HEATING LAYOUT.



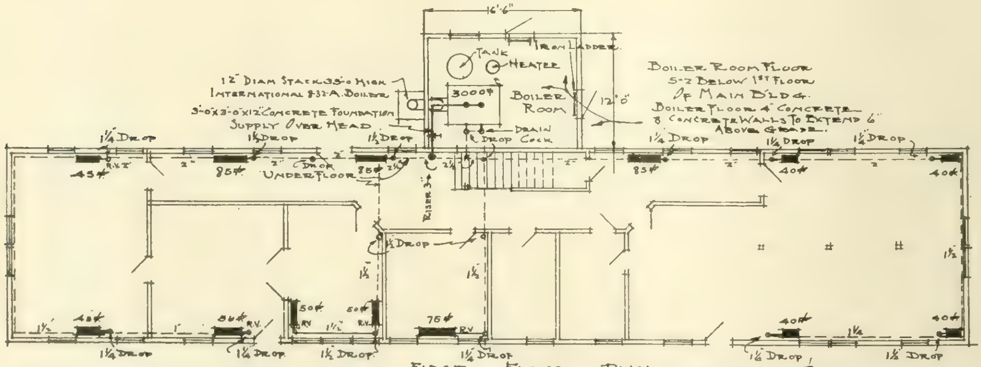
BASE HOSPITAL UNIT (SINGLE WARD), CAMP UPTON.


HOT WATER STORAGE TANK
FURNISH & INSTALL AUTOMATIC WATER FEEDER WITH BY-PASS IN FEED LINE TO BOILER
DROP
"PROGRESS" BOILER 728 S 2000#
BOILER ROOM FLOOR 3'-6" BELOW PANTRY FLOOR
DAMPER
BOTTOM OF TANK TO BE 30" ABOVE WATER LINE OF BOILER
DRAIN
RAILING
FIRE & BOILER ROOM
2" DIAM
OVEN
OVEN
OVEN
25'
SKYLIGHT
ABOVE TIE BEAMS
BAKE ROOM
LIVE STEAM LINE
4"
FROM BOILER
STEAM MAIN
RETURN
24"
WATER LINE OF BOILER
SECTION SHOWING METHOD OF CONNECTING TO RADIATORS ON WALL
SECTION "A-A"
SHOWING METHOD OF CONNECTING TO CEILING RADIATORS
6 SEC 9# PER SEC WALL RAD 54#
5 SEC 9# PER SEC WALL RAD 45#
LAVATORY
LOCKER ROOM
A
ECCENTRIC BUSHING
RADIATION IN THIS ROOM TO BE 6 SEC 9# PER SEC WALL RAD TOTAL 54# FOR EACH UNIT
BREAD ROOM
STEAM MAIN PITCH 1/2" IN 10'0"
PROOF ROOM
GATE VALVE
DROP
RADIATOR 3 COL 38"
OFFICE
RETURN AT FLOOR
RUN BELOW TIE BEAMS
ALL RADIATORS 3 COL 38"
MIXING ROOM
ABOVE TIE BEAMS
BELOW TIE BEAMS
RISE TO FLOOR
UNDER FLOOR
AT FLOOR
STORE ROOM
80#
65#
55#

BAKERY BUILDING, CAMP UPTON.



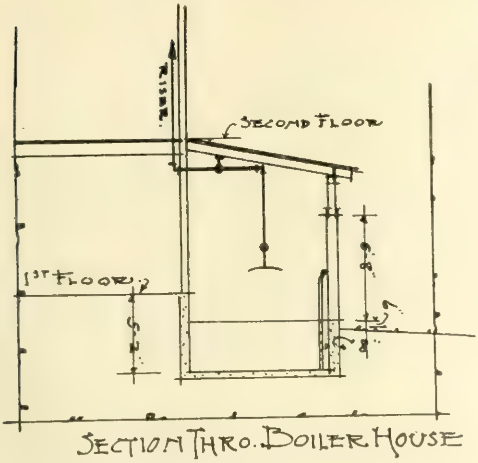
SECOND FLOOR PLAN


16'-6"
IRON LADDER
TANK
HEATER
12" DIAM STACK 35'-0 HIGH
INTERNATIONAL 832-A BOILER
3'-0"x3'-0"x12" CONCRETE FOUNDATION
SUPPLY OVER HEAD
3000#
BOILER ROOM
12'0"
DRAIN
DROP COCK
BOILER ROOM FLOOR 5'-2 BELOW 1ST FLOOR OF MAIN BLDG.
BOILER FLOOR 4" CONCRETE 8" CONCRETE WALLS TO EXTEND 6" ABOVE GRADE.
1¼ DROP
1½ DROP
DROP UNDER FLOOR
RISER 3
85#
83#
40#
45#
50#
75#
R.V.
RV
1½ DROP

FIRST FLOOR PLAN

R.V. = RADIATOR VALVE
ALL RADIATORS TO BE 3 COL. 38" HIGH

MEDICAL DEPARTMENT BUILDING (ARTILLERY), CAMP UPTON.

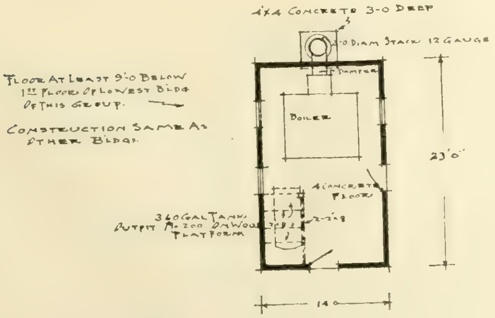


SECTION THROUGH BOILER HOUSE, MEDICAL DEPARTMENT BUILDING.

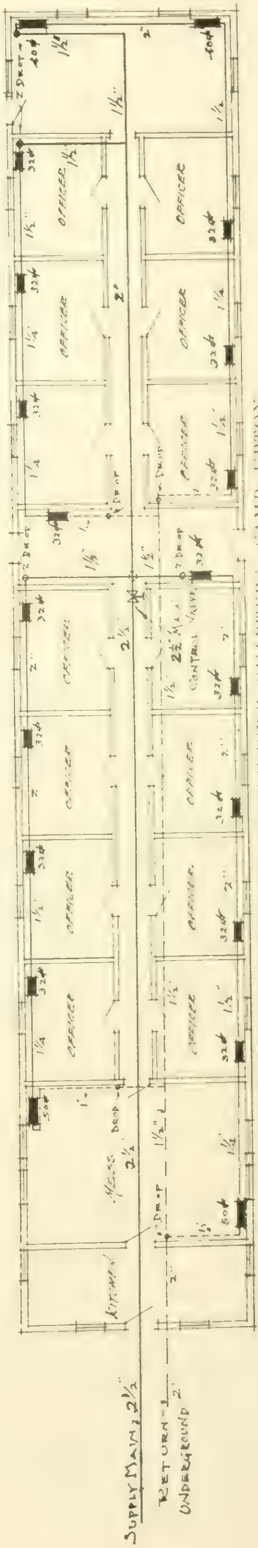
The general arrangement of the steam distribution is the same as in the officers' quarters, except that the steam distributing mains are carried to the ceiling of either the first or second floor, with a drop-feed system, the return lines being run above the floor. In these buildings the radiators on the second floor are placed directly on the floor, while those on the first floor are raised on pedestals, as previously described, with the return lines running underneath.

BARRACKS.

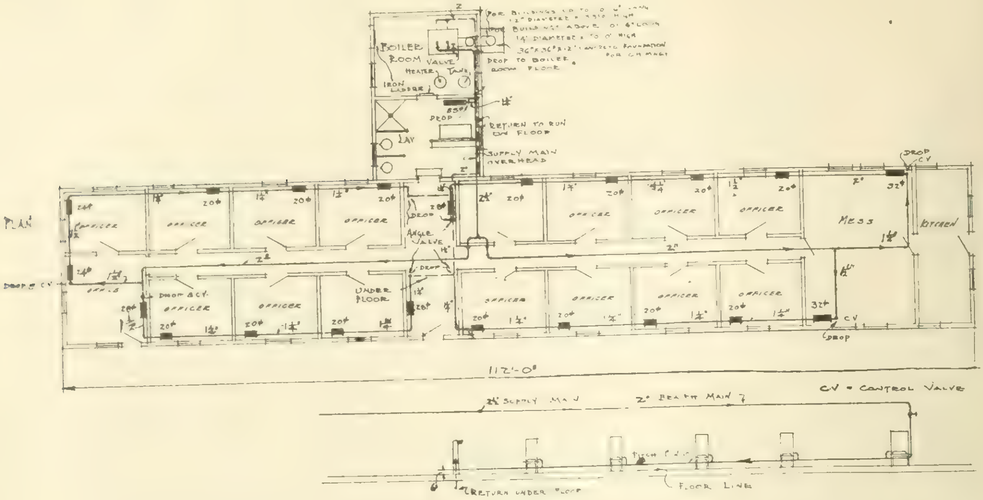
In general the barracks are two-story buildings, 140 × 43 ft., divided by a hall in the center on the first floor. This part of the barrack is heated by a stove and the rooms on either side of the hall are heated by room heaters which are placed


4x4 Concrete 3-0 Deep
Diam Stack 12 Gauge
Floor at least 9-0 below 1st floor of lowest bldg of this group.
Construction same as other bldgs.
Damper
Boiler
23'0"
Concrete Floor
360 Gal Tank
Platform
14-0

BOILER HOUSE, DIVISION HEADQUARTERS, CAMP UPTON.



DIVISION HEADQUARTERS, OFFICERS' QUARTERS, CAMP UPTON.



DIVISION HEADQUARTERS, OFFICERS' QUARTERS (MAIN BUILDING), CAMP UPTON.

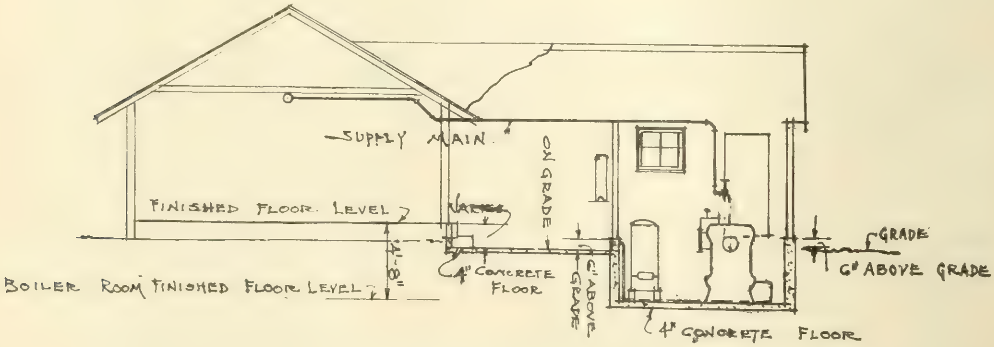
substantially in the center of the room. The second floor is heated by two room heaters placed substantially in the center of the space to be heated. There are approximately 250 of these buildings at Camp Upton, in addition to other types of barrack buildings.

With a problem so large as the building of sixteen cantonments, each capable of housing approximately 40,000 men, and with the building of approximately thirty-two other camps, all requiring heat, it will be understood that the difficulties of securing sufficient and suitable material were very great. The resources of the country had to be mobilized.

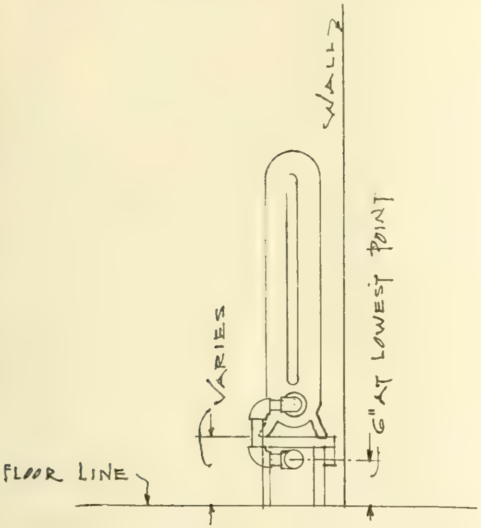
In passing it might be stated that several of the sixteen National Army cantonments have group steam heating plants, including many more steam-heated buildings than at Camp Upton.

HEATING REQUIREMENTS.

In connection with the heating requirements the hospital groups of the various cantonments were computed for the maintenance of 70° F. in zero weather. In the more northern locations an increased amount of radiation was provided, and in southerly locations, less radiation was installed. The officers' quarters and the barracks were com-



SECTION THROUGH OFFICERS' QUARTERS, (MAIN BUILDING.)



RADIATOR DETAIL, OFFICERS' QUARTERS.

puted for a temperature of 60° F. The capacity of the room heaters was figured on the basis of the approximate amount of coal burned per square foot of grate, with an assumed efficiency of the heater.

In spite of the tremendous exertions put forth to have the cantonments finished on time, there were some remarkably close connections made which will long remain the talk of the trade.

With the approval of the Secretary of War, the following statement concerning the heating facilities of the various cantonments is made by Brigadier-General Isaac W. Littell, in charge of cantonment construction:

Four camps are steam heated throughout, with the exception of a few small units using stoves, constituting less than 10%. These four cantonments are Camps Devens (Ayer, Mass.), Custer (Battle Creek, Mich.), Grant (Rockford, Ill.), and Funston (Fort Riley, Kan.).

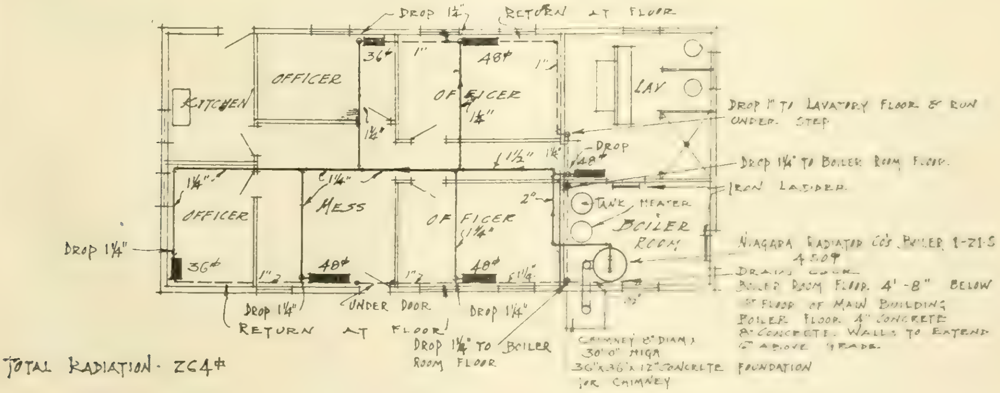
The remaining 12 have steam heat in hospitals and officers' quarters. The barracks are heated by large hot-air furnaces, as are the mess halls. There are four large heaters to each barrack.

Such delay as has occurred has been mainly in the installation of steam-heat facilities. Temporary stoves were put in use to offset the slight chill of October weather wherever permanent heating plants were not complete.

Work at Camp Devens was somewhat delayed by the failure of manufacturers to deliver as rapidly as promised the necessary fittings, valves and piping. With the arrival of materials, steam fitters were put to work, and, in most important parts of the work, in shifts for the 24 hours of the day.

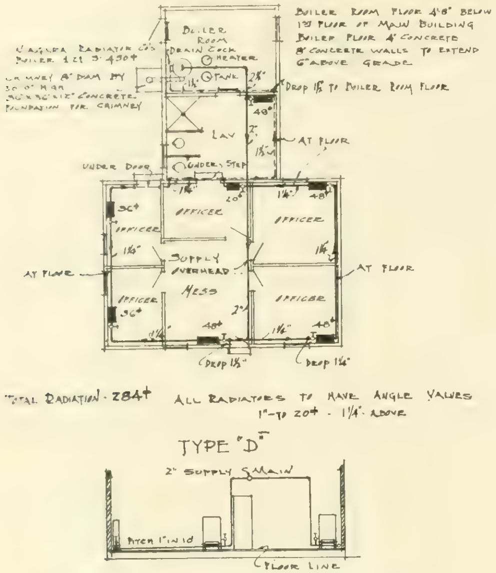
At Camp Custer, Battle Creek, 9 of the 14 steam plants are in service and approximately 300 stoves have been set up pending completion of the remainder of the steam-heat apparatus.

At Camp Grant, Rockford, 12 out of the 15 steam plants are in service and completion of the entire system was scheduled by October 23.


DROP 1¼"
RETURN AT FLOOR
KITCHEN
OFFICER
36#
1"
48#
1"
OFFICER
1¼"
1¼"
LAV
DROP 1" TO LAVATORY FLOOR & RUN UNDER STEP
1½"
1¼"
DROP
48#
DROP 1¼" TO BOILER ROOM FLOOR
IRON LADDER
1¼"
1¼"
OFFICER
MESS
OFFICER
1¼"
2"
TANK HEATER
BOILER ROOM
NIAGARA RADIATOR CO'S BOILER 1-21-S 450#
DRAIN COCK
BOILER ROOM FLOOR 4'-8" BELOW 1st FLOOR OF MAIN BUILDING
BOILER FLOOR 4" CONCRETE
8" CONCRETE WALLS TO EXTEND 6" ABOVE GRADE
DROP 1¼"
36#
1"
48#
1"
48#
1¼"
DROP 1¼"
RETURN AT FLOOR
UNDER DOOR
DROP 1¼"
DROP 1¼" TO BOILER ROOM FLOOR
CHIMNEY 8" DIAM 30'0" HIGH
36"x36"x12" CONCRETE FOUNDATION FOR CHIMNEY
TOTAL RADIATION - 264#

TYPICAL OFFICERS' QUARTERS, CAMP UPTON.

At Camp Funston, Fort Riley, there were 140 steam fitters and 140 helpers engaged in the work of installing the steam plants. Three out of the 18 proposed are in service.


Boiler Room Floor 4'8" below 1st floor of Main Building
Boiler Floor 4' Concrete
8" Concrete walls to extend 6" above grade
Boiler Room
Drain Cock
Heater
Tank
Niagara Radiator Co's Boiler 121 3-450+
Chimney 8" diam by 30 0" high
30"x30"x12" Concrete foundation for chimney
Drop 1½ to Boiler Room Floor
2½"
1¼"
48"
Lav
2"
1½"
At floor
Under Door
Under Step
1¼"
20"
Officer
1¼"
48"
36+
Officer
1¼"
Supply Overhead
Officer
1¼"
At floor
At floor
Mess
Officer
96+
Officer
2"
48+
1¼"
1¼"
48+
Drop 1½"
Drop 1¼"
Total Radiation - 284+
All Radiators to have Angle Values 1"-to 20+ - 1¼"-above
TYPE "D"
2" Supply Main
Ret'n 1" in id
Floor Line

OFFICERS' QUARTERS, TYPE D, CAMP UPTON.

In the remaining 12 cantonments the room furnaces are practically all in place and the heating arrangements are well advanced.

The system of steam heating adopted for the first four cantonments named is the same as is used by many industrial plants where the units are widely scattered.

The overhead system of steam heating for these four cantonments is the best obtainable for cantonment purposes. The question of loss of heat is a matter of insulation entirely. Either an overhead or underground system will lose heat if the insulation is imperfect. The plans call for complete insulation of the pipes, and the heat will be as well preserved overhead as underground. Overhead piping is not only cheaper, but may be more quickly installed and more readily repaired.

Ventilating Conditions in Textile Mills

In spinning rooms of mills employees occupy from 500 to 1,000 sq. ft. of floor space, and so, for usual story heights, from 5,000 up to as much as 12,000 cu. ft. of space, per employee. The window openings will vary from as little as one-fifteenth to as high as one-sixth in unusual cases. The average will probably be about one-tenth. Weave-shed workers will occupy about the same amount of floor space in general as that given for spinning employees, whereas the cubic space will be even greater. Not all weave sheds are well supplied with windows, but the ventilators usually placed in the peak of the sawtooth skylights will act in the place of windows.

It must be evident that so far as the amount of space per employee and the available openings to outside air are concerned, textile mills seem to be well ventilated, and general experience would seem to bear out this conclusion. In some individual mills, poor conditions undoubtedly obtain, due to local influences which it is impossible to consider in this paper. Actual conditions must be studied over a long period of time in order to determine whether the ventilation of any particular mill is sufficient.

However, ventilation is a subject that cannot be considered absolutely alone, for proper ventilation is affected seriously by and in turn itself affects two other factors, temperature and humidity, both of which in their inter-relations have serious effects on health.

In most modern textile plants the relative humidity is kept at or near a constant point by artificial apparatus for manufacturing reasons, and it thus becomes necessary to maintain the temperature of the workrooms at that point in relation to the humidity which will result in the greatest comfort to the employees; in other words, to provide only so much external heat as is necessary to prevent the body radiating more heat than it produces. *W. Fred Dolke, Jr.*

CHICAGO COMMISSION ON VENTILATION

Organization of the Chicago Commission on Ventilation

The Chicago Commission on Ventilation was organized in February, 1910, so that it is now in its eighth year. In 1914 the commission published a lengthy report of its work up to that time which included tests made by the commission on the ventilation of passenger cars, picture theatres, an experimental schoolroom, an office and an experimental cabinet.

Much experimental work of great value and importance has been done since 1914. By a special arrangement with the Chicago Commission on Ventilation, the reports of this work, as well as all future tests and experiments, will appear exclusively in the columns of THE HEATING AND VENTILATING MAGAZINE, except that the commission will have reprints available, following publication.

It will be of interest to our readers to know that at the organization meeting of the commission, in 1910, it was agreed that:

1. In the construction of new buildings, ventilation is not receiving the consideration which its importance warrants.

2. Our present methods of ventilation are based on standards which are more or less traditional and without scientific foundation.

3. All the factors which influence the ventilation of a building are not understood.

4. The importance of ventilation makes it most desirable, if not entirely necessary, to conduct such experiments as will make the practice of ventilation a branch of applied science.

THE WORK OF THE COMMISSION.

Except for the work done with the experimental cabinet, all studies and tests conducted by the commission are made in rooms or buildings of full size, and substantially under normal conditions of use. Much criticism is sometimes offered against conclusions drawn from studies made with models or miniature structures usually housed within a room. If such criticism be just, then it is fortunate that the commission's work was necessarily done in enclosures of full size and built in accordance with various architectural designs.

One of the first things the commission undertook was to make a general study of the ventilation in restaurants, cafés, hotel dining rooms, bakeries, printing offices, office buildings, and other places in which health might be impaired because of the lack of good ventilation. Some of the present ordinances in the Chicago city code are based upon these studies.

PERSONNEL OF THE COMMISSION

Organizations having representation in the Chicago Commission on Ventilation, together with a list of members:

CHICAGO DEPARTMENT OF HEALTH.

John Dill Robertson. E. Vernon Hill, M.D.

CHICAGO BOARD OF EDUCATION.

John Wilkes Shepherd. John Howatt.

ILLINOIS CHAPTER, AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

Samuel R. Lewis. James H. Davis.
H. M. Hart.

ILLINOIS CHAPTER, AMERICAN INSTITUTE OF ARCHITECTS.

George Beaumont.

ILLINOIS SOCIETY OF ARCHITECTS.

Meyer J. Sturm.

WESTERN SOCIETY OF ENGINEERS.

Fred J. Postel.

CHICAGO SECTION, AMERICAN CHEMICAL SOCIETY.

William D. Harkins.

MUNICIPAL TUBERCULOSIS SANITARIUM, OF CHICAGO.

C. P. Caldwell, M.D. F. Bowden De Forest, M.D.

HONORARY MEMBERS.

W. A. Evans, M.D. George B. Young, M.D.

CHICAGO COMMISSION ON VENTILATION

Ventilation Test of the Lewis Champlin School

Conditions Found in a Modern Chicago School Building Equipped with the Latest Type of Heating and Ventilating System.

Introduction.

The introduction into and removal from a building of a given amount of air do not constitute ventilation. The introduction into and removal from a room of enough air to change the entire contents of the room in a given time do not constitute ventilation.

It is necessary so to deliver and remove the air that it shall reach all of the occupants. It is necessary to deliver it at such speeds and temperatures that it shall not be uncomfortable to the occupants. It is highly desirable to condition the air so that it is properly moist, and also so that a minimum amount of dust is carried with it.

When all of the windows in a room are opened and there is a breeze outside, the entire contents of the room are swept out very rapidly, amounting to a horizontal displacement of all of the air in the room in, say, sixty seconds. Such ventilation as this is not practicable in cold weather except at intervals, for very short periods, to flush the room. Much dust may enter the room with such ventilation. The limitations as to cost of heating apparatus and fuel have restricted ventilation to a very much smaller range than that above mentioned.

WINDOW VENTILATION.

Where windows are used for admitting cold air, the amount admitted depends on the facilities provided to permit its escape, and on the capacity in the heating system available for warming it in addition to that needed merely to overcome the loss of heat through the cool walls and glass. Thus, reasonable ventilation undoubtedly can be obtained, under skillful manipulation of the windows for rooms occupied by one or two persons per window, especially when chimneys are provided for effecting a constant air removal. When more air is admitted by windows than can be heated to nearly the room temperature almost instantly, there will be cold drafts and discomfort, unless the occupants are especially dressed to offset this. By "reasonable ventilation" we assume the standard commonly used, 30 cu. ft. of fresh air per minute per person, which again means by CO_2 index about six parts of carbon dioxide per 10,000 parts of air. Thirty cubic feet of air per minute per person will do nicely when but 30 cu. ft. per minute have to be brought in through one window and there is a large cubical content of warm air to mix with or dilute it, but the problem becomes more difficult in an elementary school room having fifty occupants. In school rooms there are seldom more than six windows on the windward side and at the best each window would have to supply eight pupils. With such ventilation, those near the windows get the best of the fresh air; also the most of the drafts and dust. When the weather is inclement, rain or snow also enter, with unfortunate results.

CONDITIONS FOR ADVOCATING WINDOW VENTILATION.

For the foregoing and many other reasons, we can not advocate for standard practice in elementary schools with pupils in normal health any system of window ventilation of which we have ever heard. We do recommend the use of windows whenever the weather permits their operation without discomfort, and we do recommend the frequent flushing of the rooms by opening all of the windows.

LIMITATIONS OF GRAVITY VENTILATION.

There are so-called gravity systems of ventilation for schools which attempt to overcome the objectionable features of window ventilation by providing means for heating the entering air, and such systems usually employ heated chimneys to do the work of air carrying. These systems when at their highest efficiency, are quite similar as to interior conditions to the mechanical systems of school ventilation. Unfortunately, the highest efficiency of such systems is dependent on the human element and the difference in temperature between indoors and outdoors and is greatly affected by wind. Gravity ventilation has no advantages over mechanical ventilation, except that it is usually less expensive in first cost. It gives no results in any phase which surpass mechanical ventilation, and is subject to all of the objections which follow the latter. It is usually more expensive to operate from the fuel standpoint.

CONDITIONS WHICH SHOULD GOVERN VENTILATION.

It is, of course, desirable to arrive at some specific amount of air which should be introduced in each minute for each occupant. So far as we know, the carbon dioxide content of the air is not the condition which should govern ventilation. We use the CO_2 content merely as an index of the air supply and distribution, although so far as is known no quantity of CO_2 practicably possible in respired air is of any particular harm. In the light of present knowledge, ventilation must be governed by temperature, moisture, odor, the dust carried in the air, and other factors, as well as the chemical condition of the air. Ventilation is efficient if the air in its passage evenly renews the aerial envelope about the bodies of the people, and if the removal of the contaminated air is prompt and direct.

Practice in the art of designing ventilation systems has developed, for the Chicago elementary schools, apparatus which will furnish a minimum of 1,500 cu. ft. of air per minute for each fifty pupil class-room. This amount of air is far short of the 10,000 cu. ft. per minute possible with all windows open. To deliver even 1,500 cu. ft. per minute, however, is a real problem. The air should be as free from dust as possible; it must cause no noise as it passes through the ducts and registers. It must even at this quantity (say, an air change once in seven minutes) be warmed to within about ten degrees of the room temperature, or much discomfort from drafts is occasioned. It must be moistened so as to reduce the temperature necessary for comfort and to minimize evaporation from the bodies of the pupils.

VENTILATION IS BY DILUTION, RATHER THAN BY DISPLACEMENT.

The delivery of enough air through the supply register to change the contents of the room once in seven minutes does not mean, unfortunately, that the contents will all be changed. The entering air may be sufficient in quantity and there may be installed positive means of removing from the room a like amount, but even so, the distribution of the fresh air usually is very uneven. Air is so elastic, and changes its weight per unit volume so quickly in response to changes in temperature that ordinary ventilation necessarily has to be largely by dilution, rather than by displacement.

VENTILATION BY DILUTION DEFINED.

Ventilation by dilution may be described as the ventilation in any room which has cold walls, any local source of heat, such as radiators, stoves or animals, and which has a comparatively small constant air supply and exhaust, whether above or below atmospheric pressure. Such ventilation results from every local contact of air with objects of different temperatures, which cause an upward or a downward current of considerable proportions, regardless of whether the air is fresh or contaminated.

We have built small toy windmills which will be caused to revolve by the rising current of air actuated by the heat of the human hand. The entering fresh air, if warmer than the air in the room, rises to the ceiling; if cooler, it falls to the floor. If the outlet is at the floor and convenient to a downward fresh and cool current, the fresh air will short circuit out, leaving the contaminated air in blissful occupation of the breathing zone. Under such conditions, of course, each warm thing in the room would be promoting the dilution by causing the fresh air to rise to replace the air warmed and so pumped up by contact, and each cool thing, such as the windows, would be causing the displacement from the floor into the breathing zone of fresh air, by the falling currents of cooled contaminated air.

VENTILATION BY DISPLACEMENT.

Ventilation by displacement may be described as the ventilation in any room when the windows are opened on each side so that the wind may cause a complete horizontal displacement. Where it is possible to introduce fresh warmed air through an opening under each seat, as in many theatres and churches, the ventilation is by displacement, if it rises directly to the ceiling and so passes out. Practically, ventilation by displacement is only possible under such conditions or where a very small difference in temperature may be obtained between the room and the entering air, without local or cold surfaces to cause vertical mixing current. Some interior rooms of buildings having no heaters and no windows or cold walls are satisfactorily ventilated by displacement with air movement from side to side at the breathing zone. Ventilation by displacement is not practical in the ordinary class-room as now constructed.

The Chicago Commission on Ventilation, however, has had an experimental class-room, using this principle, in use under observation, for several years. This class-room has inlets for fresh air under every desk, and is provided with special air chambers under the floor and over the ceiling.

STANDARD EQUIPMENT FOR CHICAGO SCHOOLS.

The Chicago schools are practically all equipped with mechanical ventilation, and the standard procedure is to arrange the ventilating systems so as to deliver a minimum of 30 cu. ft. per pupil per minute, under a slight pressure, occasioned entirely by the resistance of the duct systems. The pressure at the supply fans is depended upon to deliver the air to the rooms and gradually to force the contaminated air out of the rooms through flues to the roof ventilators. This pressure is seldom sufficient to overcome the inward leakage due to the wind and usually such is this leakage that rooms to windward show more air leaving the rooms through the exhaust flues than is entering through the supply flues, while the rooms on the lee-side show very much less air leaving by the exhaust openings than is delivered by the fan. This leakage in and out through walls and windows is a well-known phenomenon, and is not particularly objectionable, as it assists in the ventilation, when ventilation by dilution must be used.

Experiments have been made which show that a ten mile per hour breeze is approximately sufficient to balance the static pressure ordinarily maintained in the Chicago schools.

A heated room and a heated building are under a considerable air pressure out at their tops, due to the tendency of the lighter heated air to rise, and under a corresponding cool air pressure in at their bottoms. If a window in a heated room be opened there will nearly always be a draft outward at the top, and inward at the bottom, no matter what sort of heating system is used.

Test of the Lewis Champlin School

Princeton and Englewood Avenues,
Chicago, Ill.

The selection of the Lewis Champlin School for testing was brought about by the following considerations:

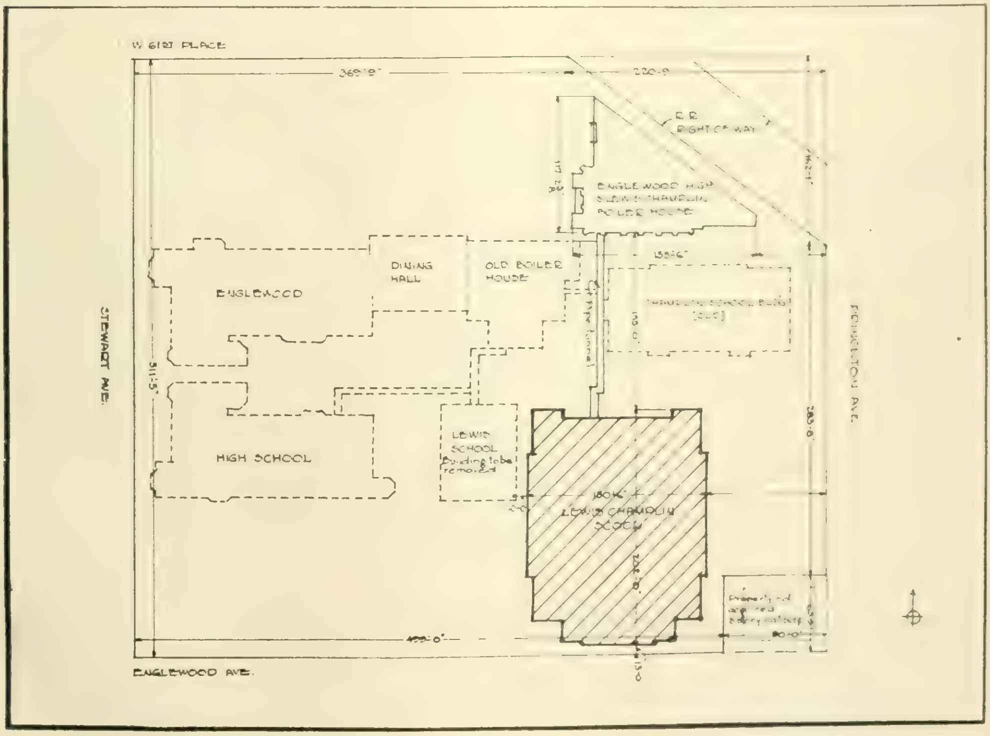
It is one of the latest Chicago schools to be put into service, having been completed in the fall of 1916, and has presumably as modern and efficient an equipment for heating and ventilating as any in the city.

It is large enough to give representative rooms, as it is built to accommodate about 1,100 pupils.

It has arrangements whereby the air may be recirculated within the building, by using the corridors as return ducts.

PURPOSE OF TEST.

The immediate purpose of the test was to obtain information as to the efficiency of the ventilating system, particularly as to air distribution within the rooms, and as to the condition of the air, as deter-

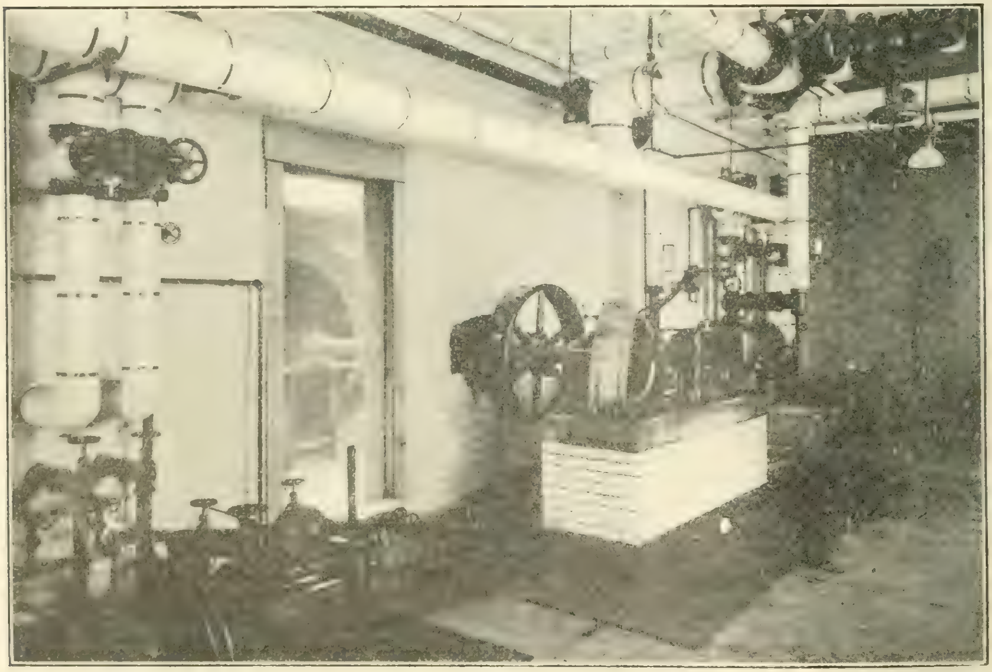


PLAT PLAN, LEWIS CHAMPLIN SCHOOL, CHICAGO AND NEIGHBORING BUILDINGS.

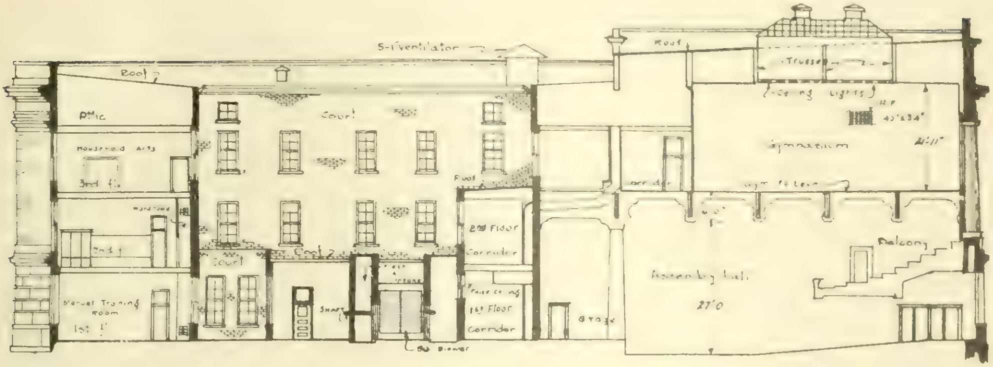
LEWIS CHAMPLIN SCHOOL.

mined by simple chemical, bacteriological and physical observations. The ultimate purpose is to determine whether or not any improvements in the design for operation of the plant can be suggested, in accordance with the general desire of the Chicago Commission on Ventilation to determine means whereby the air conditions inside buildings may approximate the best air conditions outside buildings.

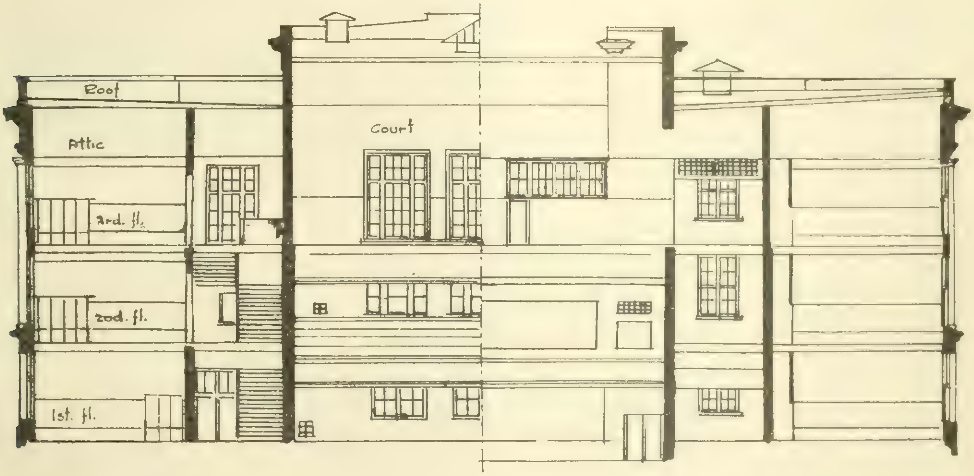
The building is about 200 ft. × 145 ft., three stories high, of fireproof construction, with a shallow attic space and flat roof.



ENGINE ROOM, LEWIS CHAMPLIN SCHOOL.

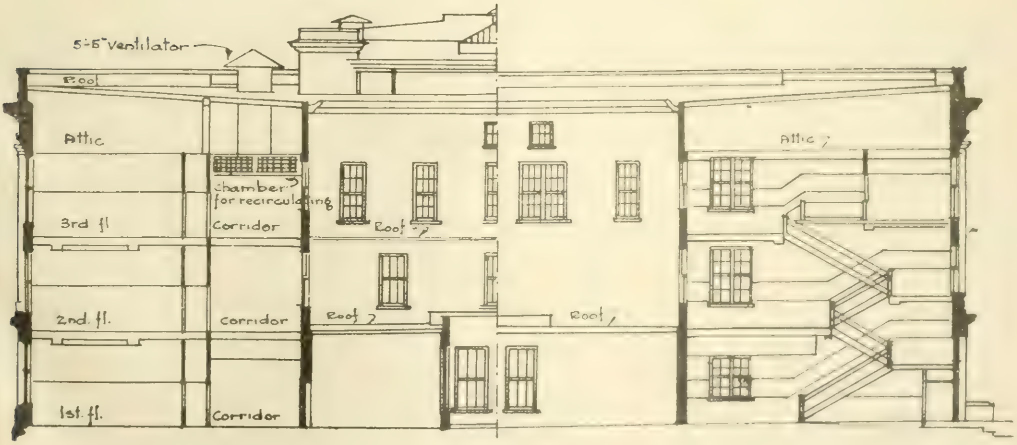


SECTION C-C.



SECTION A-A

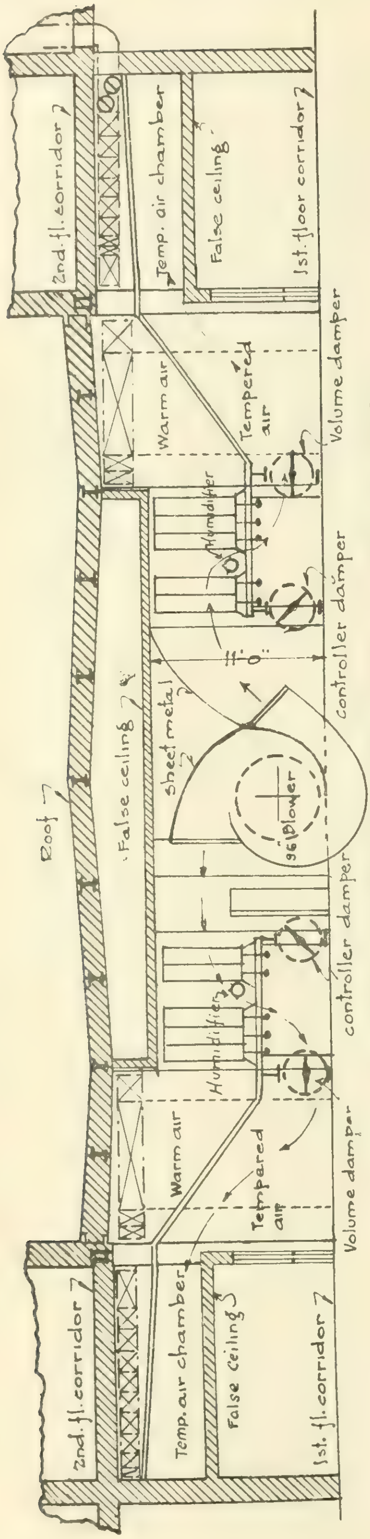
SECTION B-B.



SECTION D-D

SECTION E-E

SECTIONAL ELEVATIONS, LEWIS CHAMPLIN SCHOOL.



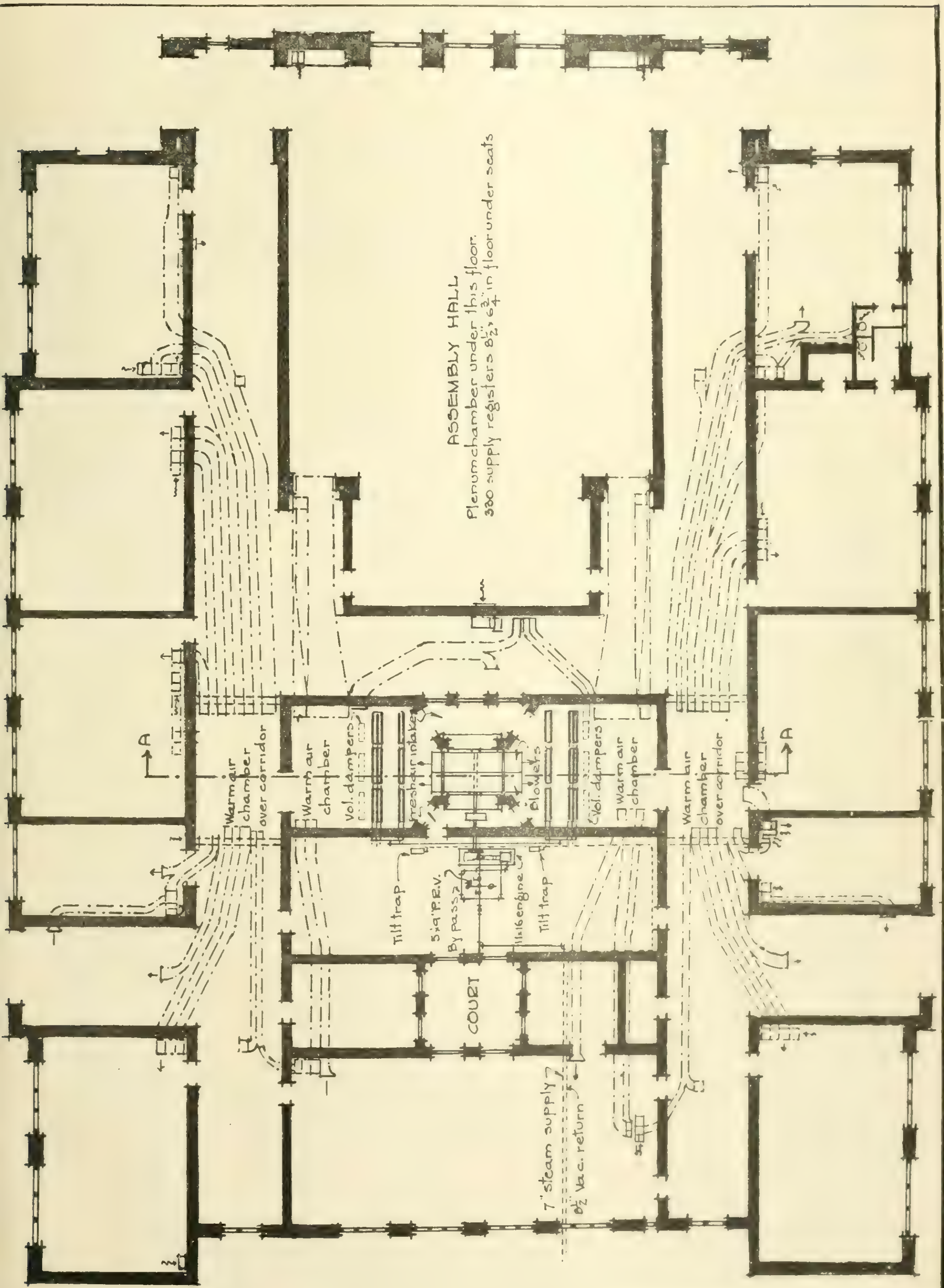
SECTION THROUGH HEATING CHAMBER, LEWIS CHAMPLIN SCHOOL.

COURT OF LEWIS CHAMPLIN SCHOOL, SHOWING INTAKE AND VENTS ON ROOF.

DESCRIPTION OF SYSTEM.

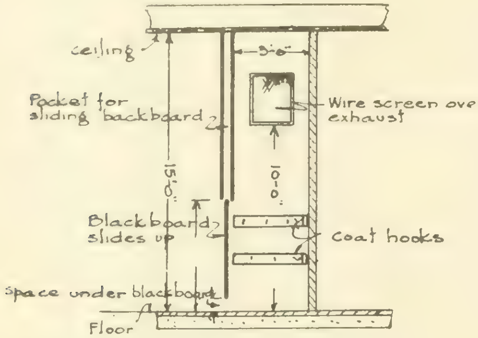
Steam at about 90 lbs. pressure is supplied from a detached boiler-house through a tunnel. The heating is accomplished with exhaust steam, supplemented with live steam, introduced through an automatic pressure regulator, and is circulated at not exceeding 3 lbs. pressure. The returns are under the suction of a vacuum pump in the boiler-house.

The fresh air supply is drawn from an interior court, paramount to taking it from the third floor level. It passes through the engine-driven fan, then through heaters arranged so as to provide two temperatures of air, one at about 120° F., the other at about 60° F. The hot air (120°) is delivered into the upper part of a large plenum chamber, and the tempered air (60°) is delivered into the lower part of the chamber. There are two such chambers in the Lewis Champlin School. From these chambers comparatively small horizontal metal ducts extend along the ceiling to the first floor rooms, and to the bases of the vertical flues leading to

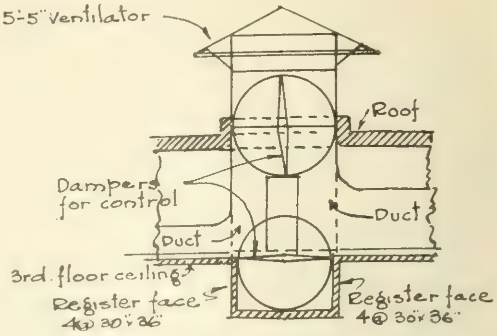


VENTILATION SYSTEM, LEWIS CHAMPLIN SCHOOL.

the second and third floor rooms. In each of these ducts there is placed a double mixing damper, actuated by a thermostat in each room, so arranged that by taking either hot or tempered air, or part of each, the temperature in the duct may be at any required point between 60° and 120° (approximate limits). This variation in temperature is intended to be accomplished without any variation in air volume.



SECTION THROUGH WARDROBES, SHOWING METHOD OF EXHAUST.

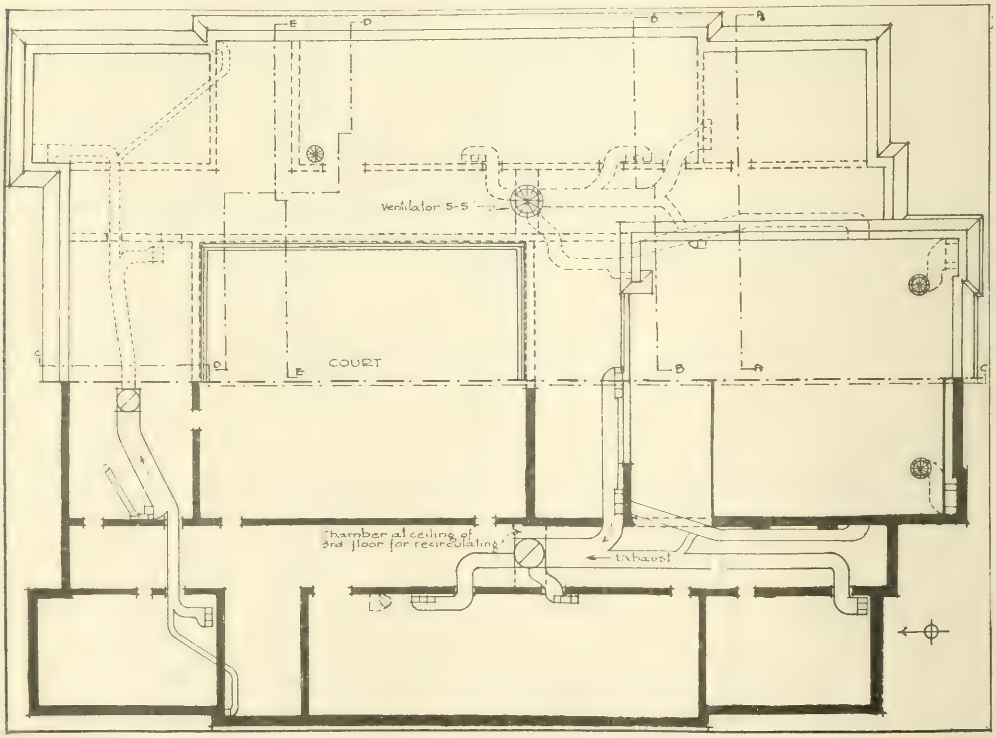


SECTION OF TYPICAL VENTILATOR AND RETURN AIR CONNECTIONS.

(One in East and One in West Corridor, Third Floor.)

METHOD OF MOISTENING AIR.

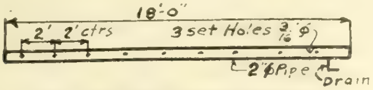
Steam jets, controlled by automatic humidity controllers, are provided in each of the two main air chambers and arranged to bring the steam in contact with the air at an air temperature of about 60°. It is ordinarily practicable with this type of humidity introduction to obtain 50% relative humidity at 70° F. dry bulb temperature, whether hot



VENT DUCTS AND CONNECTIONS, ROOF AND ATTIC, LEWIS CHAMPLIN SCHOOL.

air or tempered air is being introduced.

By manipulation of the dampers controlling the admission of air to the tempered air chambers, it is possible to close entirely all air supply to them when heating the building prior to occupancy, obtaining a cumulative heating effect since, as room after room reaches a temperature of 68°, the hot air dampers are closed by the thermostats, and the hot air supply which has heated them automatically is diverted to hurry up the heating of the remaining cold rooms, until, finally, the entire heating power of all of the indirect radiation in each plenum chamber goes to the slowest room to heat. The rooms which have reached 68° are, of course, not ventilated during this period, but are stagnant, since all tempered air is closed off. There is no objection to this procedure if used prior to the arrival of the pupils; moreover, it is an effective step toward economy.



STEAM JET HUMIDIFIER.

LOCATION OF AIR INLETS AND OUTLETS.

The air enters the standard classrooms about 7 ft. above the floor, and leaves them under the bottoms of the sliding wardrobe partitions, which also carry the blackboards. Passing upward over the clothing in the wardrobes, the air passes in flues to the attic. In most cases, the wardrobes are on the same sides of the rooms as the inlet openings, but in some cases they are directly opposite. In the auditorium, the air enters through a large number of evenly distributed floor registers beneath the seats, and leaves mostly at the floor level, through flues in the outside walls. In some other rooms, of special type, the air leaves the rooms through registers at the floor level, on the same side of the rooms as the supply openings. The toilet rooms are ventilated by separate flues and are so arranged that the toilet room air can not be recirculated.

The general building vent flues are connected in the attic with metal ducts to two outlet chambers. These are open at the top to roof ventilators, and at the bottom to large grilles on the ceiling of the third floor. Pneumatically-operated dampers permit the air to escape out of doors, or to pass down into the corridor, when it is desired to recirculate the air.

SIZES OF APPARATUS:

Boiler plant—1,200 H.P., in central plant, which supplies several other buildings in the Englewood High School group.

Supply fan—Multiblade type, 70-in. wheel, double wide, double delivery, double inlet, capacity about 90,000 cu. ft. per minute at 160 R.P.M.

Engine—Direct-connected, 11 in. × 16 in., throttling, about 160 R.P.M.

Tempering Heaters—2,860 sq. ft. surface, 1 in. pipe in cast-iron bases, center-bottom single, pipe connection.

Reheaters—4,292 sq. ft. surface, 1 in. pipe in bases of the same type.

Tests were made by employees of the Chicago Commission on Ventilation, using the standard methods and appliances of the commission, described in general in the appendix to the 1914 report.

In addition to those devices, the dust counter of Dr. E. V. Hill, 1917 type, was used instead of the Aitken dust counter. Unless otherwise stated, air volumes were taken as described, by calibrated anemometer. The temperature readings, unless stated otherwise, were taken at 4 ft. above the floor.

Preliminary tests, to establish familiarity with the practice, and for development of the program, were made at various times in January and February, 1917. The dates of the various tests appear on the charts.

The various conditions observed will be presented in next month's issue of THE HEATING AND VENTILATING MAGAZINE *under the following heads, as observed in the various rooms:* (1) *Air volume (distribution, motion);* (2) *Temperature;* (3) *Moisture;* (4) *Dust; and* (5) *Bacteria. Test sheets will also be shown covering observations of rooms* 104, *the kindergarten and Rooms* 201, 209, 301, 304 and 305.

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BY THIS time the heating installations in the great army encampments are practically complete, as far as the plans laid out by the Constructing Quartermaster's office are concerned, but our readers will not fail to notice that where stove heaters have been installed the government officials, as well as heating men generally, have gone on record as stating that this type of heater was used only on account of the exigencies of the situation and that "as a general proposition steam heating would have been favored above furnace heat, but the element of time was the deciding factor." Again, in the recent discussion in these columns of the substitution of "squad houses" for the regulation army barracks, it is stated that "the best system would be steam heat from a central plant and cast-iron wall radiators in the barracks."

The barrack buildings constitute the greater part of each cantonment; at Camp Upton, for instance there are 359 barrack buildings.

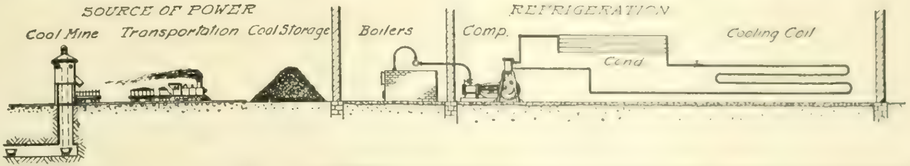
It is becoming more evident every day that these cantonments are not to be temporary propositions but are to serve as permanent training quarters, not only during the present war, but afterwards, when compulsory military service becomes the law of the land. It is, therefore, of great importance that the makeshift of stove heat for the barracks should be replaced by adequate heating systems as soon as possible and it is none too soon for heating engineers to take up this matter and be prepared, when the first lull comes, to do their part in equipping the camps for permanent service.

WE TAKE pleasure in announcing this month that through an arrangement with the Chicago Commission on Ventilation, THE HEATING AND VENTILATING MAGAZINE will hereafter represent the commission to the extent of publishing all reports of its tests and experiments. These reports will appear exclusively in this magazine, except that separate copies will be published by the commission for special distribution. Although the commission has published only one report, in 1914, it has not been idle by any means. The investigations and tests it has carried on not only cover a wide range, but have been made, as far as possible, on strictly practical lines in rooms or buildings of full size.

As nothing, since the 1914 report, has appeared, dealing with the commission's work, our readers may look forward with unusual anticipation to the forthcoming issues.

Each issue will be devoted to one report or more, the first being that of the ventilation tests made early this year in the Lewis-Champlin School, Chicago.

AIR COOLING AND REFRIGERATION



Air Cooling in A Chewing Gum Plant

One of the most interesting features of air cooling is its application to buildings, not for the sake of comfort, but for the purpose of making certain manufacturing processes a success. There are many manufacturers today who are experiencing troubles whose remedy lies unknowingly only in proper air conditioning, not alone as far as temperature is concerned but also in regard to the relative humidity which is best suited to the particular operation concerned. Gum manufacturers knew that on certain days the gum got too soft, and on other days it got too hard and brittle but they did not know the remedy, and it has been due solely to the initiative of certain manufacturers of air conditioning equipment that the remedy is now being applied, resulting in more perfect work and higher efficiency throughout.

Such an installation was recently installed by the Carrier Engineering Corporation, New York, in the plant of the American Chicle

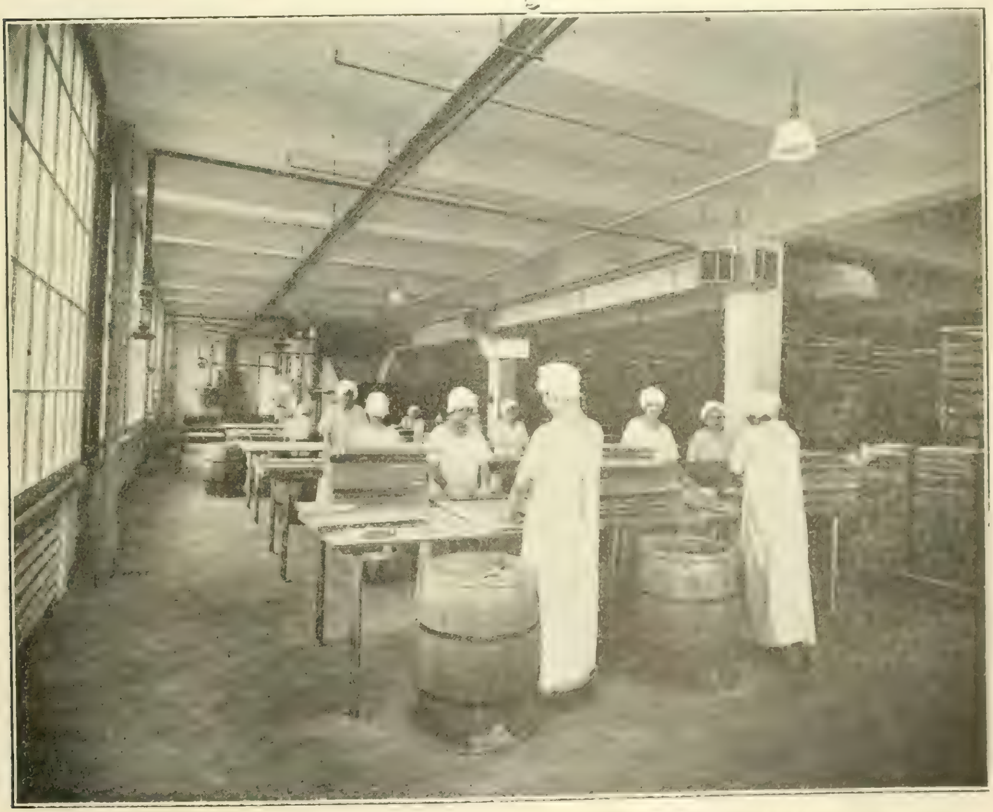


FIG. 1—ARRANGEMENT OF DUCT SYSTEMS IN ROLLING, SCORING, SEASONING AND TRIMMING DEPARTMENTS, AMERICAN CHICLE COMPANY.

Company, Long Island City, and a brief description of the process of gum manufacture is essential to an appreciation of the value of the results accomplished.

COMPOSITION OF CHEWING GUM

In the first place, chewing gum is the result of various ingredients mixed together after being properly cooked, in which chicle is the important factor. Chicle is the product which is refined from the sap taken from the Sapoto tree which is a native of tropical climate, especially Yucatan and the southern part of Mexico, as well as the northern part of South America.

The crude chicle brought to this country in pieces weighing from 100 to 200 lbs. per piece contains anywhere from 10% to as high as 35% of moisture. In the process of converting the crude chicle into chewing gum, it is first taken to breaking-up benches; here it is handled by the operatives who chop the large mass into smaller pieces, sort out the different grades and colors and at the same time clean out the refuse, such as bark, twigs, leaves, etc. After properly cleaning the chicle, it is usually ground up into small granules about the size of a wheat kernel in a mill and then dried.

The drying of chicle has always been considered a rather difficult proposition to perform properly, requiring from 40 to 45 days by the use of the older method employed which was primarily to place the chicle on trays and in a room heated with direct steam coils. This time, however, has been greatly reduced and the proper drying procured in from 17 to 24 hours with the use of the Carrier differential vapor tension regulation. In the drying of chicle it is necessary to retain a certain definite percentage of moisture within the material to facilitate the next process of filtering same through filter presses after the mass has been cooked.

Air conditioning is not essential in the various processes the chicle undergoes after it leaves the drying room until it comes into the roll and scoring department. The processes in which air conditioning is not required comprise primarily the cooking, blending, etc. From the cooking department the chicle is brought into the roll and scoring department, containing the different flavors and all other ingredients. Here it is rolled into flat slabs of proper thickness, then scored by passing through the final rolls which impress the deep score of the proper size and shape into the gum.

HIGH TEMPERATURE IN THE SCORING ROOM

The roll and scoring department, due to the large amount of heat generated, is apt to experience high temperatures which aided by the evaporation of moisture from the gum is not always a comfortable room in which to work. It is not unusual to find the humidity and temperature so high as to cause sugar to liquefy and become a sticky, sirupy agglomerate. De-humidifying is very important, not only from the above mentioned standpoint, but to control and maintain the proper percentage of moisture in the gum while passing through the various rolls.

From the roll and scoring department the slabs or sheets of scored gum are passed on to the seasoning or so-called drying rooms, where the material is put on trays and allowed to season for a day or two.

It is very important that this department be conditioned to control the air, humidity and temperature since the percentage of moisture evaporated or allowed to remain in the gum is dependent on the conditions of the air.

If this gum, in the seasoning process, dries out too much it will be hard and very brittle, but if not enough moisture is removed, trouble is experienced in the next department where (becoming very plastic) it will cause a sticking of the gum to the wrapper, sweating and various other disadvantages.

From the seasoning room the gum, loaded on trucks, is passed along to the breaking-up or trimming-room. The gum upon entering the trimming-room must contain sufficient moisture so that it will not be too brittle and cause fracturing, yet must be sufficiently dry to break evenly and easily into shape as scored.

From the trimming-room the perfect slab gum is taken into the wrapping-room, which should also be properly conditioned to maintain a fixed and definite temperature and humidity. Thus the gum is wrapped and sealed to assure uniformity in quality of product.

The above relates to what is known as slab gum, while the process of chiclets, ball gum, or what is commonly known as tablet gum, is very similar to that of the slab shape, with the following exceptions:

From the trimming-room the separated mass of chiclets is taken to the coating-room where the same are put in revolving coating pans; the process here is to tumble them continuously while hot sugar syrup is applied to same at intervals until the tablets or balls have become encrusted with a sufficient and requisite sugar coating of proper thickness. The coating-room is usually an exceedingly warm room, due to the constant supply of hot air which is blown into the tumbling mass of gum for the purpose of rapid drying. If this air is properly applied and exhausted much of the heat will not be liberated into the workrooms, thus prevening oppressive conditions now so usual in gum manufacturing.

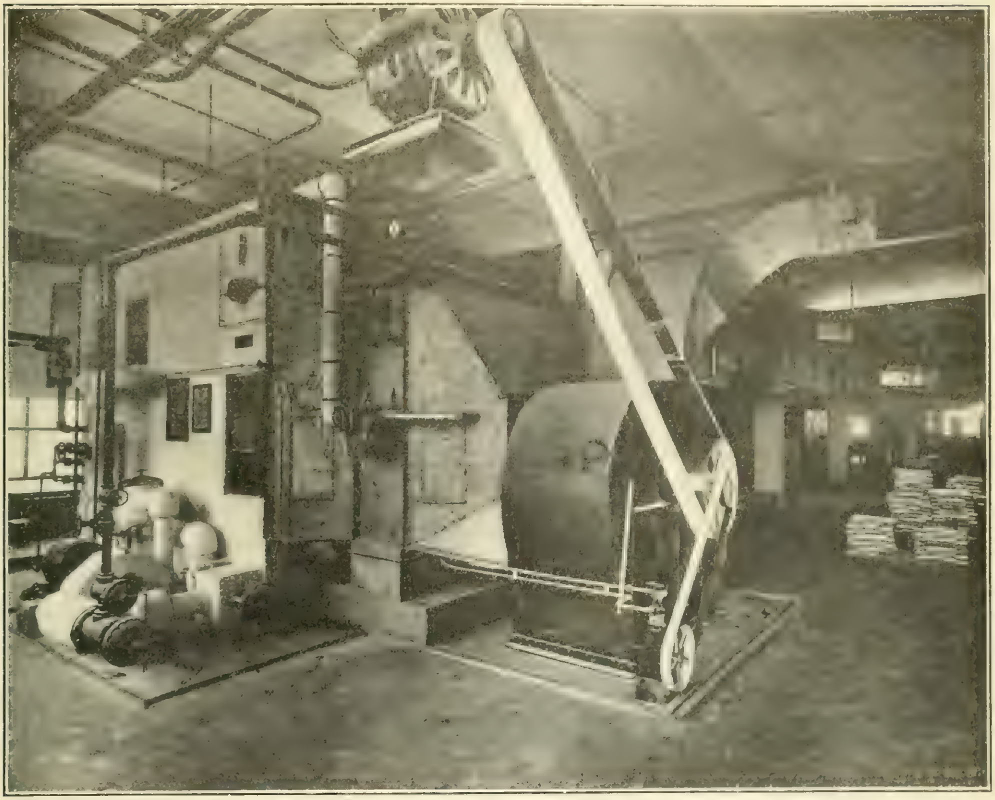


FIG. 2—DE-HUMIDIFIERS, VENTO HEATERS, FAN, ETC., PLANT OF AMERICAN CHICLE COMPANY.

From the coating pans, in some of the plants, the coated gum is taken to an enclosed room, known as the polishing-room, where coating-pans of like design are employed merely to tumble the gum for the purpose of polishing the surface of same. Instead of hot air, cold air is applied which, in addition to the room air, should be maintained at a fixed and predetermined temperature and low humidity to prevent the losing of the polished surface after it is attained, and which is highly desirable.

CAPACITY OF PLANT AS INSTALLED

The apparatus for the plant under discussion is designed to maintain 70° F. temperature in the rooms so requiring throughout the year with a constant relative humidity carried at all times. The exact percentage of this humidity, however, is kept strictly confidential in order to protect the owner's interests. In order to do this a de-humidifier of special design is installed with a capacity of 25,000 cu. ft. per minute which serves the rolling, scoring, seasoning and trimming departments, a room approximately 178 ft. x 87 x 13 ft equipped with double-sash on all windows.

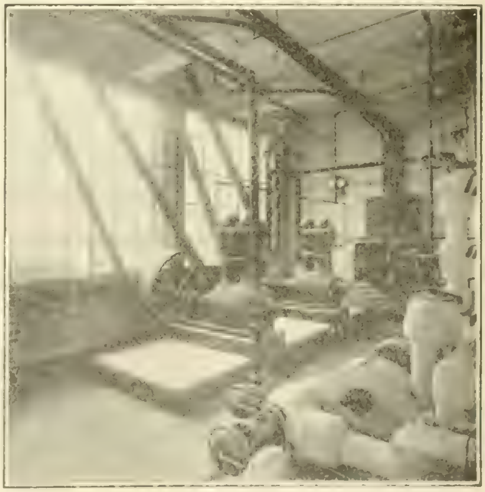


FIG. 3—REFRIGERATION APPARATUS, PLANT OF AMERICAN CHICLE COMPANY.

The complete apparatus consists of the de-humidifier (just mentioned) Vento heaters (for winter use) a fan (to circulate the air) a circulation pump (for the de-humidifier water) and two ammonia compressors, with a condenser and cooling coils for the purpose of cooling down the re-circulated spray water used in the de-humidifer. Two complete duct systems run on the ceiling are installed as may be seen by reference to the view shown in Fig. 1. Here the nearer duct with the horizontal outlets is the supply duct and the farther duct with the vertical inlets is the exhaust duct.

The supply duct system is designed to distribute the air uniformly throughout the room without drafts. The supply outlets are all made horizontal in direction and each is controlled with a volume regulating damper; the outlet velocities are figured so as not to exceed 500 ft. per minute and the quantity of air is made sufficient so that the entering temperature need never be less than 50° F.

ARRANGEMENT OF AIR DUCTS

Parelleling the supply duct is the exhaust duct with all inlets looking downward and properly controlled by volume dampers. This duct picks up the air at the various points where the inlets are located and carries it back to the cooling apparatus, to be re-treated. Of course, one recirculation opening could be provided at the apparatus, but this would result in drawing all the air from the room towards this point which is objectionable owing to the fine sugar dust and sugar particles with which the air becomes filled, due to the processes of manufacture.

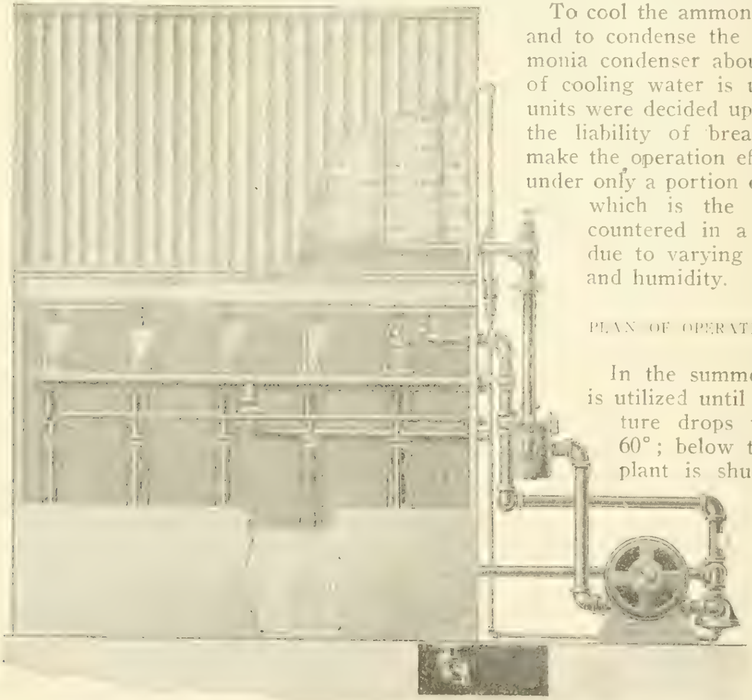


FIG. 4 SPRAYS AND WARM WATER TANK IN DEHUMIDIFIER.

For this reason the air is picked up at various points and carried back in a separate duct to the inlet of the apparatus. The economy of the system is very apparent when it is considered that approximately all the air is re-circulated constantly, re-washed and cooled, yet *with* ventilation provided in correct quantities by the operation of fresh and return air dampers automatically.

Fig. 2 is a view of the de-humidifier, the Vento heaters (standing on the heavy concrete foundation and encased in galvanized iron) the fan, driving motor and circulation pump. The fan is a Carrier Niagara Conoidal No. 8, driven by a 10 H.P., A. C. motor, and the circulation pump is a Buffalo double-suction centrifugal spray pump with a horizontal split shell and operated by a direct connected 7½ H.P., A. C. motor with a flexible coupling. The pump circulates about 200 gal. of water per minute to carry on the necessary cooling on days of maximum temperature.

The cooling of the spray water is accomplished by a refrigeration plant consisting of two 30-ton York ammonia compressors, each belt driven by a separate 35 H.P., A. C. motor set on the floor above, as shown in Fig. 3.

To cool the ammonia compressor jackets and to condense the ammonia in the ammonia condenser about 75 gal. per minute of cooling water is used. Two ammonia units were decided upon in order to render the liability of break-down less and to make the operation efficient when operated under only a portion of the maximum load which is the usual condition encountered in a plant of this kind, due to varying outside temperatures and humidity.

PLAN OF OPERATION IN SUMMER TIME

In the summer time refrigeration is utilized until the outside temperature drops to between 50° and 60°; below this the refrigeration plant is shut down and, as the outside temperature continues to fall, warmer spray water and finally the Vento heaters are cut in to maintain constant room conditions. During the summer the *temperature* of the cool supply air is kept constant while the amount of circulation is automatically varied. In the winter, or heating season, circulation is kept constant while the temperature of air delivered into the room is varied to suit.

The de-humidifier used cools the spray water by refrigeration within the apparatus itself. The sprays and warm water tank are located in the upper chamber as illustrated in Fig. 4, while the lower chamber contains the cool water tank and direct expansion Baudelot ammonia coils; the water of the sprays falling into the upper pan overflows through overflow pipes into the flooding trough below, the ends of the overflow pipes being carried below the surface and thereby water-sealed. Thus the upper chamber is not only separated from the lower one but has all connections between the two water-sealed.

Regulation of the amount of moisture retained by the air leaving the de-humidifier is obtained by controlling the spray water temperature; this is accomplished by a three-way mixing valve by-passing, in correct proportions, water from the upper tank directly to the suction line of the circulation pump where it is mixed with the cold suction water which (not having been by-passed) has flowed over the ammonia cooling coils. Thus, whenever too much cooling is being done the operation of this mixing valve raises the temperature of the cooling water and consequently the air, and vice versa.

LEGAL DECISIONS

License Fees for Inspection of Pipes.

A city ordinance required an annual inspection of all pipes and mains of gas, water, steam heating and other companies maintaining or operating such pipes and mains in the streets, avenues, and alleys of the city, imposing an annual license fee of $30 for each mile of pipes and mains. In proceedings for the reduction of the license fee it appeared that no regular inspection was made by the city other than that made by the police, fire, engineering, and street departments as incidential to their other duties, and that no extra expenses were incurred for such inspection, and that the cost of such inspection did not exceed $7.50 per mile. It was held that the amount fixed by the ordinance was excessive, and the city would not be permitted to collect more than $7.50 per mile for inspection. *In re* Pennsylvania Gas Co., Pensylvania Supreme Court, 101 Atl. 996.

Charges for Heating.

The Oklahoma Supreme Court holds, Guthrie Gas, Light, Fuel and Improvement Co. v. Board of Education, 166 Pac. 128, that an order of the corporation commission requiring that natural gas be furnished to the board of education of the city of Guthrie for heating the public school, at a rate different from and less than that charged to other consumers, is not by reason of the discrimination in favor of the public schools alone invalid. The board of education and the gas company entered into a contract under which the boards istalled a system of heating by natural gas in the public schools, and the gas company furnished gas to the board for heating purposes at a certain rate and maintained that rate for a considerable period of time. Thereafter the rate was changed to a different and higher rate at the request of the supply company from whom the local company obtained the gas and because the rate furnished to the board was discriminatory as compared with rates charged to other consumers, and not because the rate granted to the board deprived the gas company of a just return upon its investment. It was held that the evidence showing these facts was sufficient to justify an order by the Corporation Commission requiring a rate to the board of education different from and less than that charged by the gas company to other consumers in the absence of a showing that said rate fixed by the commission, in connection with the rates charged to other consumers, deprived the gas company of a just return upon its investment.

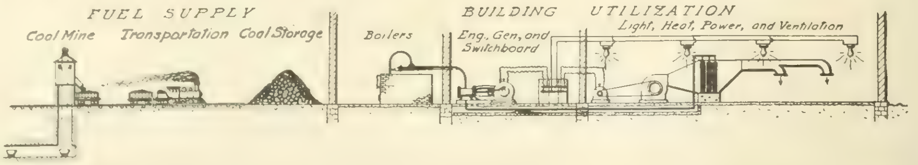
Parol Evidence to Supply Omissions in Contract.

The Michigan Supreme Court holds, Sparks v. Lord, 164 N. W. 490, that in a suit for the balance of the price of installing a heating system, where the written contract showed that in its preparation the degrees of temperature which the system was guaranteed to produce were inadvertently omitted from the schedule provided, parol evidence of a verbal agreement that the house was to be heated to 72° F. was admissible.

Death.

C. A. Blessing, Philadelphia, Pa., founder and owner of the heating and plumbing supply business conducted under his name, died at his home in Glenside, Pa., October 21. He was 75 years old. Mr. Blessing was a pioneer in the plumbing supply line, having patented the first one-piece, copper-lined bath-tub which was principally responsible for his success.

POWER PLANT ENGINEERING



Feed-Water Heating

As is well known, there are two main reasons for heating feed water: (a) to economize on fuel consumption and, (b) to prevent temperature strains on the boilers, due to the feeding of cold water. On account of the first consideration exhaust steam is utilized whenever possible and, because of the second, a high pressure make-up, carried through a reducing valve, is used where the supply of exhaust steam is not sufficient or is used for other purposes.

Owing to the serious troubles resulting from getting oil into the boilers, the closed type of feed-water heater was favored for a long time because this heater does not allow any mixing of the water and the steam. Thus exhaust steam containing oil can be used with impunity in a closed heater although the oil will coat the outside of the tubes in time and make the scraping of them necessary.

The common closed heater consists of a cast-iron or steel shell containing the brass or copper water tubes through which the water passes. The steam occupies all the space between the shell and tubes and these heaters are, therefore, sometimes termed "water-tube" heaters; they are usually placed on the boiler-feed pump discharge line and for this reason are also sometimes called "pressure heaters." Fig. 1 shows a heater of this type as manufactured by the Alberger Heater Company.

For the purpose of preventing the accumulation of scale on the inside of the water tubes, due to precipitation of the water while heating, the tubes are sometimes made spirally corrugated (as shown in the cut) may have a wire bent into a spiral shape placed on the inside, somewhat like the rifling of a gun barrel, or the tubes themselves may be bent into a long coil form, the idea of all these being to impart to the water a rotating scouring motion as it passes through the tubes so as to prevent the formation of scale.

ADVANTAGES OF CLOSED HEATERS

Closed heaters occupy less room than open heaters of equal capacity and are cheaper to install. Their efficiency in the transmission of heat to the water from the steam is not quite as high as the open heater and unless copper tubes are used they may become subject to electrolysis. Their chief recommendation is the fact of absolutely keeping oil out of the feed-water which, in some cases, is more important than 1% or 2% higher efficiency of heat transmission with the danger of oil.

ADVANTAGES OF OPEN HEATERS

With the exception of the oil danger, open feed-water heaters have a large number of desirable features the most important of which consist of (a) higher heat transmitting efficiency, (b) greater storage capacity of hot water ready for a sudden load on the boilers, (c) made entirely of iron they experience no trouble with electrolysis, (d) they remove scale and sediment from the feed water and (e) serve as a receiver for all sorts of drips, returns, trap discharges, etc., utilizing the heat contained therein.

The usual open heater consists mainly of a ribbed cast iron shell usually 3 ft. to 4 ft. square and 5 ft. to 7 ft. high. Into this the exhaust steam enters (after passing through an oil separator) and is confined within the shell; a small vent pipe is connected into the top of the heater to prevent its becoming air bound and to relieve the air separated from the heating water. The feed-water to be heated is then dripped or sprayed through the steam, condensing it, and the mixture falls toward the bottom passing through a filter and into the boiler feed pump suction line.

The water line in the heater is held up to a given level by a ball float which opens the cold water make-up line whenever the returns or other sources of feed-water are not sufficient to meet the boiler demands. If too much water is brought back to the heater it overflows through a water-sealed overflow to the sewer. In Fig. 2 is shown a type of open feed-water heater, this being the Cochrane heater, made by the Harrison Safety Boiler Works.

FEED-WATER HEATER AN ECONOMIC NECESSITY IN PLANT OPERATION

Viewed from any point the use of a feed-water heater is not only desirable but is an economic necessity to secure efficiency in plant operation. It must not even be looked upon as an additional item of cost for as a matter of fact, it will so reduce the work done by the boilers in ordinary cases as to make practical either the elimination of one boiler altogether or else a reduction in the size of boilers otherwise required without the heater.

For instance, assume a given installation, without a feed-water heater, with the feed-water coming in at 50° F. and using steam at 150 lbs. gauge. According to the steam tables there will be in the steam at 150 lbs. gauge 1195 B.T.U., while the water at 50° F. contains 18 B.T.U. The difference, or 1195—18=1177 B.T.U., is being supplied by the boiler to every pound of steam generated.

With a feed-water heater of open type installed, the feed-water probably could be raised to 210° F. before entering the boiler, resulting in a saving of 210°—50°, or 160°, which means 160 B.T.U. that the boiler does not have to furnish on each pound of steam generated or 160/1177 = 13.6% saving.

This means a reduction of about one-seventh of the total boiler load so that, where seven boilers were required *without* a heater, six will do the same work *with* the heater. Or, another way, if 100 HP boilers are required *without* a heater 86 HP boilers can be used *with* a heater and perform the same work; that is furnish the same number of pounds of steam at the same pressure.

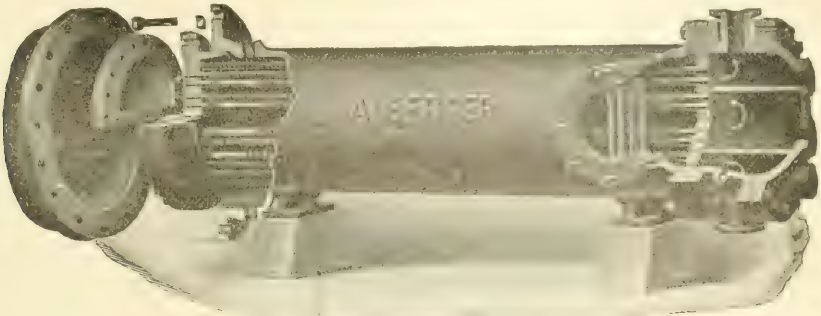


FIG. 1—TYPE OF CLOSED FEED-WATER HEATER

ECONOMY FOR VARIOUS INITIAL AND FINAL TEMPERATURE OF FEED WATER

The following table has been computed for a steam pressure of 70 lbs. gauge and shows the saving for various initial and final temperatures of feed water.

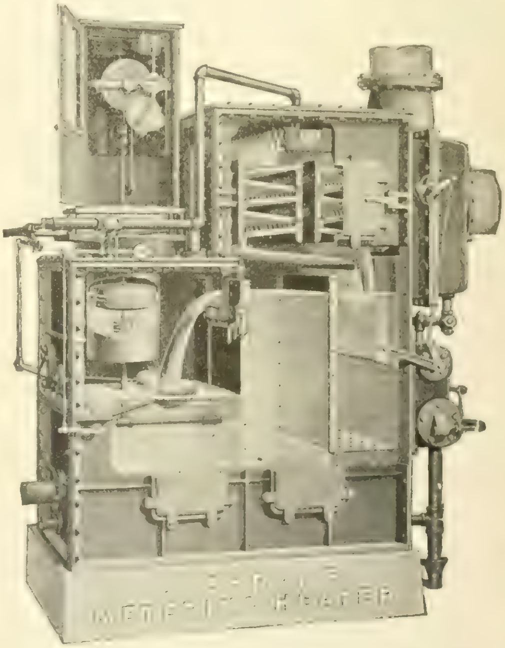


FIG. 2—TYPICAL OPEN-FEED WATER HEATER.

Initial Temp. Feed Deg. F.	Temperature to which Feed is Heated							
	100	120	140	160	180	200	220	300
	SAVING IN PER CENT							
35	5.53	7.24	8.95	10.66	12.38	14.09	15.81	29.34
40	5.12	6.84	8.56	10.28	12.00	13.73	15.45	28.78
45	4.71	6.44	8.16	9.90	11.62	13.36	15.09	28.22
50	4.30	6.03	7.76	9.51	11.24	12.98	14.72	27.67
55	3.89	5.63	7.37	9.11	10.85	12.60	14.35	27.12
60	3.47	5.21	6.96	8.72	10.47	12.22	13.98	26.56
65	3.05	4.80	6.56	8.32	10.08	11.84	13.60	26.02
70	2.62	4.38	6.15	7.92	9.68	11.45	13.22	25.47
75	2.19	3.96	5.73	7.51	9.28	11.06	12.84	24.92
80	1.76	3.54	5.32	7.11	8.80	10.67	12.46	24.37
85	1.30	3.11	4.90	6.70	8.48	10.28	12.07	23.82
90	0.89	2.68	4.48	6.28	8.07	9.98	11.68	23.27
95	0.45	2.25	4.05	5.86	7.66	9.47	11.29	22.73
100	0.00	1.81	3.62	5.44	7.25	9.07	10.88	22.18

The saving effected by a feed-water heater is a true saving although its thermal efficiency is not as high as some other feeding devices; in this way it seems somewhat contradictory because it is seldom that a device 100% thermally efficient actually *saves* less than an apparatus of much lower efficiency. Such is the case, however, when the feed-water heater is compared to the injector; this is owing to the fact that the injector utilizes heat directly from the boiler and puts back only the heat which it takes out while the feed-water heater utilizes heat from the exhaust steam which would otherwise be thrown out into the atmosphere and wasted. Thus while it may be less efficient *absolutely* it is much more economical practically.

TYPES OF COMBINATION HEATERS

Besides the simple feed-water heater there are manufactured heaters in combination with other accessories; in fact, most open heaters are combined with oil separators. One of the most interesting and successful combinations is handled by the Standard Steam Specialty Company and is known as the Utility exhaust muffler, oil separator, return tank, pump governor and feed-water heater. A view of this is shown in Fig. 3, the general form being that of a large cylinder.

The exhaust steam enters the tank through the inlet and has its velocity greatly reduced in the first chamber, which is called the expansion chamber. In passing through this chamber the direction of flow is changed 90° and most of the entrained water is thrown out. It then passes through a series of removable chain baffle impinging surfaces which are so arranged that the course of the stream is thoroughly divided and broken up and yet are kept with such free area that practically no back pressure is created.

The oily emulsion and the oil in the exhaust are precipitated by gravity to the bottom of the oil separating compartments and the purified and dry exhaust steam then leaves by way of the outlet.

The water heating compartment is entirely separate and has no connection to the oil separator portion. The purified exhaust steam is allowed to enter the water compartment through a valved connection to the exhaust line and is brought into direct contact with the water. Clean returns are connected into the heater through a sprayer in the steam

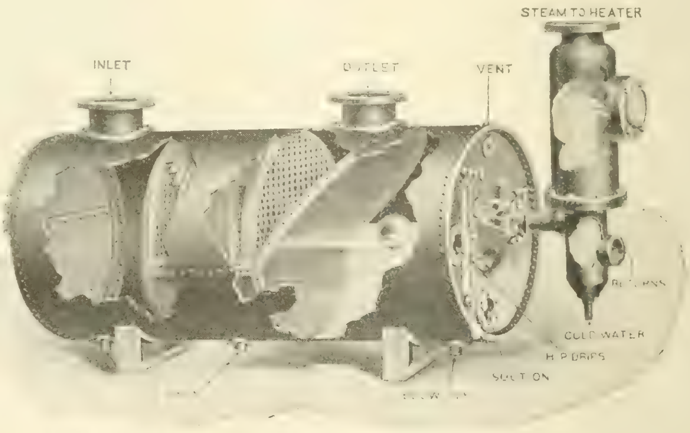


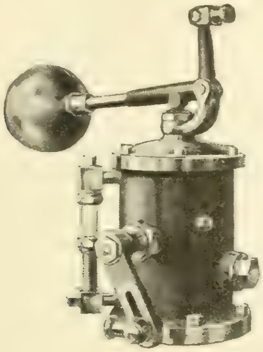
FIG. 3 COMBINATION FEED-WATER HEATER AND OIL SEPARATOR.

connection so that the returns and makeup water can be heated to around 212° by direct contact with the exhaust steam.

Another advantage is that by closing the steam valve to the feed-water side the oil separator may be still kept running regardless of any repairs which may be necessary to the feed water mechanism.

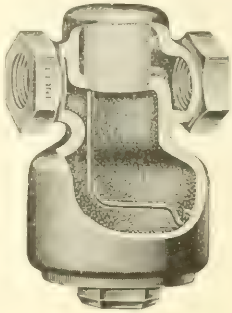
Notes

The steam pump speed governor, made by the Mason Regulator Co., Boston, Mass., is to the direct-acting steam pump what the ordinary ball governor is to be steam engine. It derives its motion from some reciprocating part of the pump and controls a balanced valve placed in the steam pipe, thereby exactly regulating the amount of steam to the requirements of the pump, and automatically maintaining a uniform speed, regardless of any variation of steam or load. By the use of a key the speed of the pump can be changed, if desired, while the pump is in motion. These governors are used on direct-acting steam pumps (both single and duplex), also on all classes of flywheel pumps, including vacuum pumps, air compressors and ice machines.



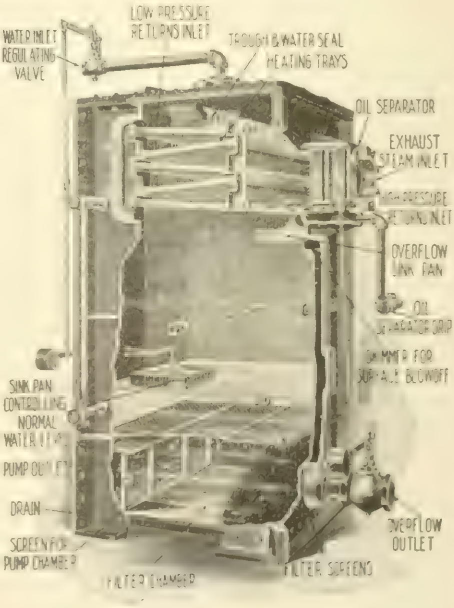
MASON STEAM PUMP GOVERNOR.

Pump suction strainers are desirable for all pumps and the H. Mueller Mfg. Co., Decatur, Ill., claims to have a particularly good design. The strainer body is made of cast-iron, galvanized, and has screw ends. The screen is made of perforated sheet brass, is cylindrical in shape and is supported in a perpendicular position in the body top by a brass spring wire stem which rests upon a ring in the bottom of the body. The bottom is a plug which can be removed to empty the sediment pocket without the screen coming out. The ½ to 2 in. sizes, inclusive, are furnished with a screen having 361 perforations to the square inch, and 2, 2½ and 3 in. sizes with a screen having 144 perforations to the square inch. In each instance the combined area of the perforation is about twice the area of the pipe connection.



MUELLER PUMP SUCTION STRAINER.

The feed-water heater made by Warren Webster & Co., Camden, N. J., consists of a cast-iron receptacle in which cold water and exhaust steam are brought into direct contact. This heater is designed upon the standard Webster principle—an exhaust steam feed-water heater, in combination with a filter and precipitating chamber. The heater is



WEBSTER FEED-WATER HEATER.

provided with an oil separator, which removes the oil present in the exhaust steam; with automatically-regulated water-supply and overflow; with quick-opening drain-valve or blow-off; with sealed outlet for the heated and purified water fed to the boiler feed-pumps; with charging and cleaning doors for the filter; with removable trays; with combination vent and inlet air-valves; with gauge-glass, and other fixtures.

The materials used in its construction are cast-iron for the shell and copper and brass for the valves and fixtures; each of which resists the destructive action of impure waters. The large heating chamber—upper section of the heater—is provided with perforated copper trays for the distribution of the water. The entire valve-gear, automatically controlling the water supply and overflow, is of brass. The exposed parts of the heater-shell are protected by heat-resisting graphite paint and all outside brasswork is brightly finished.

The War and the Heating Engineer

Call for Service Overseas.

Steam and hot-water fitters are wanted for early service overseas to serve with the enlisted Ordnance Corps, National Army. These men are needed at once. The call has gone out for steam-fitters between the ages of 18 and 40, who want to do their bit and who know their job. Modern war it is pointed out is a tremendous business, and the army that wins is the army which has the best equipment and the best men. The men are over there now—they are ready to go ahead, but they still need experts in our line to repair and maintain their equipment. There is a fine chance for every man who wants to help. Write to the Chief of Ordnance, War Department, Washington, D. C.

Skilled Workers for the Air Service, United States Army.

The Air Division of the War Department announces that more skilled workmen are needed to serve behind the lines abroad. These men must be recruited continuously, beginning immediately, until March 31. They will be employed in bringing up supplies, ammunition, food, clothing, to construct and maintain the airdromes for housing the planes and quartering the men. The Air Service calls for the following kinds of skilled workers, arranged in the order of men needed:

Chauffeurs
Auto Mechanicians
Automobile Engine, Repair Men
Office Clerks
Carpenters
Propeller Makers (Airplane)
Riggers (Airplane Assemblers)
Telephone Linesmen
Tool Makers
Radio Operators
Electricians
Instrument Repair Men
Cooks
Coppersmiths
Armorers (Machine Gun Repair Men)
Sail Makers
Photographers
Machinists
Blacksmiths
Motorcycle Repair Men
Stenographers
Cabinet Makers
Draftsmen (Mechanical)
Magneto Repair Men
Metal Workers
Automobile Engine (Testers)
Rope Riggers (Cordage workers)
Vulcanizers
Welders
Lithographers
Packers
Telephone Operators
Motorcyclists
Plumbers
Painters
Tailors
Gas Works Employees
Buglers
Moulders
Pattern Makers
Telephone Adjusters
Barbers
Truck Masters
Brick Layers
Cobblers
Propeller Testers (Airplane)
Boat Makers
Saddlers

Applicants must be physically sound, white, and from 18 to 40 years of age.

After enlistment the men will be sent to a camp for several weeks of military training. Squadrons are being formed continously. Enlistments should be sent to the Volunteer Bureau, 119 D Street, N. E., Washington, D. C., marked "for service in the Aviation Section of the Signal Corps."

Officers Wanted for Civil Engineer Corps, U. S. Naval Reserve Corps.

The bureau of Yards and Docks, U. S. Navy Department, announces that an examination will be held at the Bureau of Yards and Docks, Navy Department, Washington, D. C., to establish a list of eligibles for enrollment in the Civil Engineer Corps of the United States Naval Reserve Force. This examination will close at noon of December 31, 1917.

To compete in this examination it is only necessary for the candidate to address a letter to the Reserve Examining Board giving full information as to his education and experience with testimonials and references.

A descriptive circular giving detailed information of the requirements for this examination will be sent upon request to the Chief of the Bureau of Yards and Docks, Navy Department, Washington, D. C.

Candidate must be an American citizen and must be an engineer in active practice of the profession of civil, electrical or mechanical engineering or some business directly connected with these professions.

The age and experience requirements are for Ensign, not less than 24 years of age with not less than two years of active professional practice; for Lieutenant (junior grade) not less than 27 years of age with not less than five years of active professional practice; for Lieutenant, not less than 30 years of age with not less than seven years of active professional practice, during at least three years of which candidate must have had responsible charge of work as principal or assistant.

Enrollments are for a period of four years or during the existence of a war or national emergency. Except during a war or national emergency officers are only given active duty at their own request and then for short periods.

Pay and allowances of officers amount to approximately as follows: Ensign, $2100 per annum; Lieutenant (junior grade), $2500 per annum; Lieutenant, $3100 per annum.

There is an additional allowance of $150 per annum for uniforms.

Activities of the Shipping Board and Emergency Fleet Corporation.

Thirty-five thousand shipworkers are already wearing badges bearing the inscription "War Service Ship Building, U. S. A.", states a bulletin issued by the Chamber of Commerce of the United States. It is further stated that 1,000,000 tons of shipping will be turned out between now and March 1.

Thirtieth Engineers, Gas and Flame, Being Organized.

The first battalion of American soldiers to met offensively the gas and fire which the enemy introduced in warfare is being organized as the Thirtieth Engineers, Gas and Flame, with headquarters at Camp American University, Washington, D. C.

The battalion is being recruited from the ranks of such civil professions and trades as chemical and mechanical engineering, explosive and gas manufacture, plumbing and carpentry, and similar trades, and an exceptionally high grade of talent is volunteering.

Major E. J. Atkisson, Corps of Engineers, a graduate of West Point and of Cornell, is in charge of organization. He has specialized in mechanical and electric enginering, was formerly director of Electrical and Mechanical Engineering, U. S. Army School, and was Superintendent of Locks, Panama Canal.

It is announced that there is opportunity for a limited number of enlistments for the following classes of men: chemists, gas engineers, plumbers, electrical experts, pipe-fitters, interpreters, mechanics, chauffeurs, explosive experts, cooks, gas experts, blacksmiths, carpenters, clerks and muscular, quick-thinking, resolute men, between the ages of 18 and 40 years, for pioneer soldier service of high character. Major Atkisson has announced that any man possessing the necessary qualifications may volunteer at any recruiting station in the country by asking to join the Thirtieth Battalion Gas and Flame, forming at Washington.

Chamber of Commerce Advocates Further Price Control.

The Chamber of Commerce of the United States has gone on record as favoring additional legislation for price control of materials needed for the conduct of the war, as well as all materials affecting the public interest. It is the sentiment of the Chamber according to a referendum vote, that authority to control prices should also extend to raw materials and finished products. It was recommended that authority to control prices should be administered by a small executive body appointed by the President. The National Chamber has already gone on record as endorsing the principle of "no profit interest" in the war.

Government Contracts.

James Smyth Plumbing & Heating Co., Spokane, Wash., has been awarded the contract for the installation of plumbing and heating systems in the $25,000,000 ship building project at Hog Island, near Philadelphia. The contract will also include the installation of plumbing and heating systems in ships to be constructed in the ship yard, to the value of $250,000,000.

F. A. Clegg & Co., Louisville, Ky., installed the heating equipment in the 68 buildings comprising the hospital unit at Camp Zachary Taylor, near Louisville. The installation included 1600 radiators, totaling 80,000 sq. ft. of heating surface. Steam is supplied from a central station. The work was in charge of A. W. Clegg.

American District Steam Co., No. Tonawanda, N. Y., had the contract for installing the $100,000 heating plant for the base hospitals at the Tacoma army camp. All of the nearly 100 buildings of the base hospital unit are heated from a central plant.

At Fort Riley what is described as the leargest steam heating plant in the country has been installed at a cost of $1,000,000. The laundry will employ 250 women and 150 men working in two shifts of eight hours each. The laundry requires 200,000 gal. of water per day and the heating plant 300,000 gal.

Underground Specialty Co., New York, has received an order from the Emergency Ship Building Corporation for thousands of feet of Staten's high-efficiency sectional conduit for installation in the large ship-building plant now building at Bristol, Pa. The plant will include a housing proposition for the workers, also high-pressure lines for mechanical work. The type of conduit used will carry from one to four pipe lines. The work is being done by the William Gordon Corporation, New York.

On Government Work.

Clarence M. Woolley, president of the American Radiator Co., Chicago, Ill., has been appointed a member of the War Trade Board. In a recent announcement by the War Trade Board, it is stated that it is believed Mr. Woolley's services "will be especially valuable on the import side of the board's work because of his familiarity with the questions involved."

George W. Martin, president of the National District Heating Association, has given his services to the government in designing the heating equipment for the new large shipbuilding plants being erected in the vicinity of New York.

Walter S. Timmis, New York, has been serving as consulting engineer for the heating equipment of Camp Upton at Yaphank, L. I., W. H. Driscoll, of New York, representing the Thompson-Starrett Co., which had the contract for the mechanical equipment at Camp Upton, has had direct charge of the installation which proved a task of extraordinary magnitude.

W. F. Goodnow, of the New York branch of the American Radiator Company has been engaged in government work, making frequent trips to Washington for conferences on work in his line. Other frequent visitors to Washington on government work are Homer Addams, manager of the New York branch of the Kewanee Boiler Company, and D. Rait Richardson, of the Richardson & Boynton Company, New York.

Liberty Loan Subscriptions.

Results of the Liberty Loan drive in the metal and allied trades division in New York showed a total of $42,218,250. The machinery and machine tools division subscribed $12,888,650. Among the individual subscriptions in New York and elsewhere were the following: J. H. Williams Co., Brooklyn, $51,000; American Radiator Co. (New York branch), $50,000; National Tube Co., Pittsbugh, $2,200,000; American Radiator Co. (Buffalo branch); $100,000; Jones & Laughlin Steel Co., Pittsburgh, $2,000,000; and Youngstown Sheet & Tube Co., $2,725,000.

Coal-Saving Hints for Power Plant Owners and Managers.

A bulletin issued by the Committee on Coal Conservation of the Chamber of Commerce of the United States contains the following suggestions for conservation in the use of coal by owners and managers of power plants.

Reconsider the advantage of buying heat and power from a specialized plant that makes nothing else and can afford the investment and supervision that gets a maximum of value out of each pound of coal; in some localities hydro-electric power may be available.

Find the nearest source of coal that will meet the requirements.

Give to the power plant and its personnel recognition and encouragement.

Seek to increase skill and efficiency in the men who handle the coal.

Put the fuel-using equipment into as perfect a condition as possible.

Install simple and convenient means by

which the fireroom force may see results, scales for weighing fuel and ash, etc.

Endeavor to run boilers in service at their capacity.

Provide water that is free from scale by using, when necessary, water-treating devices if the plant is large and special feed-water heaters in small plants.

Reduce loss of heat after it is generated, see that boiler surfaces and steam pipes are properly covered, etc.

Obtain expert advice.

Burners of fuel are urged to strive after the record of present possibility of obtaining 1 H.P. on 1 lb. of coal per hour.

CORRESPONDENCE

A Steel Stack Problem.

In a recent letter to Harold L. Alt a reader states: "Having been a member of the American Society of Heating and Ventilating Engineers and having read your recent article on chimneys, I am taking the liberty of writing you to see if I am right in assuming that we would obtain bad draft in a steel stack which is erected on the outside of a building, and has the following conditions:

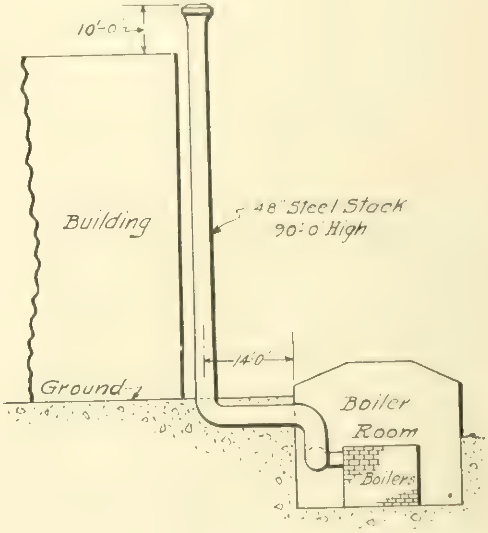
"The stack was built 48 in. dia. 90 ft. high and was figured to take care of three boilers, down-draft, Hawley-type grate, the upper grate being 32 sq. ft. and the lower grate 32 sq. ft., or a total of 64 sq. ft. in each boiler. The smoke collar at the back of each boiler is 26 in. in diameter. Only two boilers were installed, one being omitted for future extensions. We calculated the requirements for the two boilers at 36 in. dia. 90 ft. high.

"As this stack is exposed to outside weather, and has no lining inside or outside, don't we have by this excessive diameter a chilling of the stack gases and a strata of heavy air trying to fall to bottom of stack? This excess space inside of chimney must chill as the temperature of this stack, halfway up, is not hot, only warm.

REPLY BY H. L. ALT.

The conditions of draft in a stack erected as you suggest would be such as to doom the installation to failure in the production of 100% rating from the boilers.

While your inquiry does not give complete information as to horsepower to be developed and kind of coal to be used it is assumed from catalogue ratings on steel down-draft boilers that the full rated horsepower will be about 120 H. P. per boiler, making 240 H.P. to be developed now and 360 H.P. later, when the third boiler is installed.



CONDITIONS OF STEEL STACK PROBLEM.

In figuring the stack the writer—assuming common Pennsylvania bituminous coal would be used —would employ the following figures:

At 5 lbs. of coal per H.P. the rate of combustion on the upper grate (approx. 2/3 of the coal being there consumed) would be $\frac{5 \times 120 \times 2/3}{32} = \frac{400}{32} = 13$ lbs. per sq. ft. of grate area.

Then the draft loss in the fire would be about	0.15 in.
The draft loss in the boiler at 100% rating would approximate that of a H.R.T. boiler or	0.30 in.
Assuming 30 lineal feet of steel breeching 0.01 × 30/100	0.03 in.
Four 90° bends between boiler and stack 4 × 0.05	0.20 in.
Loss in stack (assumed)	0.20 in.
Allowance for contingencies	0.10 in.
Total friction to be overcome about	0.98 in.

With an *average* stack temperature of 500° F. and at sea level this would take a stack of about....	110 ft.
Stack loss of 0.20 × 110/100 = actual stack loss of............	0.22 in.
Increasing estimated friction of 0.98 to 0.98 + 0.02 =...........	1.00 in.
Height of stack at 500° F. for 1.00 in. about......................	112 ft.
Total pounds of coal for—	
1 boiler 600; pounds of gas.........	2¾
2 boilers, 1200; pounds of gas.......	5½
3 boilers, 1800; pounds of gas.......	8½
Size of stack to handle two boilers (5½ lbs. gas per second)..	30 in. dia.
Size of stack to handle three boilers (8½ lbs. gas per second)..	38 in. dia.

Therefore by *this* reasoning the stack for three boilers could be most economically sized if made 38 in. dia × 112 ft. high. But the stack under consideration is to be made 48 in. dia. (which will reduce the stack friction) so some of the height may be cut down, as the height is always dependent on the total friction to be overcome.

Looking on the curves for steel stacks to find the friction loss per 100 ft. of height for a 48 in. dia. stack handling 8½ lbs. of gas per second it is found to be very, very small; in fact, only about 0.016 in. Therefore this will reduce the total friction from the amount previously computed by 0.22 — 0.016, or 0.204.

1.00 — 0.20 = 0.80

Then the height for 500° F. at sea level need be only about 90 ft. or about 100 ft. high at 2000 ft. altitude.

But the gases are constantly cooled in an unlined steel stack to a great degree. Thus, for a 48 in. × 90 ft. high stack is as follows:

4 × 3.14 × 90 = 1129 sq. ft. outside area.

If 3 B.T.U. per square foot per degree are assumed as the approximate radiation factor, then for an *average* of 500° stack temperature and zero outside the total B.T.U. loss per hour equals

1129 × 500 × 3 = 1693500 B.T.U.
28225 B.T.U. per min.
470 B.T.U. per second

With 5½ lbs. of gas handled per second the stack loss of temperature (specific heat of air being 0.2375) will be

$$\frac{470}{5.5 \times .2375} =$$

312° drop. To maintain an average of 500° half the drop must be added to the average or 500 + 312/2 = 650° entering temperature of gas and 500 — 312/2 = 344° leaving temperature of gas.

With only one boiler running the entering temperature would have to be even higher. What would actually happen would be that the entering temperature would probably be about 500° or 550° at the highest and the average only 400° or 350° which would produce a theoretical draft of less than that computed for 500° average.

Considering the fact there is some elevation to be considered in your vicinity and that the average stack temperature will be reduced over 100° from the temperature of the gases leaving the boiler, it is fair to assume that 100% boiler rating cannot be developed, although some 60% or 80% might possibly be produced. For the conditions given, a lined steel stack, an interior steel stack or a brick stack would be much better. In any case a slightly higher stack of less diameter is suggested.

Back-Draft in Chimney.

Editor, Heating and Ventilating Magazine:

I am enclosing a sketch of a basement flat where we are unable to use the grate in the mantle owing to the fact that the draft backs down the chimney—the chimney in question has three flues in it, one leading to the mantle in basement the other two leading to the two flats above; the draft in the flues from the flats above is all right. At first I was of the opinion that the hot-water boiler on the other side of the building was the cause as there is no outside air inlet to supply that demanded for necessary combustion and the currents of air under the doorways led to the furnace room, but opening doorway (D) to boiler room from outside did not stop draft down mantle flue; all radiators in basement are on ceiling.

What would you attribute as the cause of the condition and what remedy would you suggest? Would a hood over the top of the chimney, combining the three flues in one, with a somewhat contracted area at outlet of the combined three flues, accomplish the desired result?

J. H. C.

Toledo, Ohio.

There are several features shown in our correspondent's sketch which might help to produce the back draft in the chimney flue as described. In the first place, the chimney is an outside one with one side and two ends exposed to the outer temperature, which will, of course, have a tendency to cool the flues and cause a reverse draft unless heat is supplied at the bottom more rapidily than it is radiated on the way up.

In the second place, the other flues in the same chimney are all connected to fireplaces which are undoubtedly used only intermittently, resulting in the chimney getting very cold and so reducing the temperature of the air in the flue that its weight becomes greater than the air in the house thus producing a reverse draft.

Third, the air supply for the boiler must be taken to a great extent out of the basement, there being but one door and window in the boiler-room which would hardly provide sufficient leakage to supply the necessary air for combustion.

Fourth, the Room "A" opens directly into a stairway, which may be assumed as going straight up to the top of the building and whose action will be quite like a chimney if any opening exists at the top—such as a partially open window, a ventilator, or door out onto the roof.

It is believed that the combination of all the above items produces a slight reduction of the air pressure in the basement, resulting in the back draft complained of. The correspondent displayed good reasoning in trying the experiment of opening the outside boiler-room door "D" but if this door happened *at that time* to be on the lee side of the building it might have made conditions worse instead of better. With the wind blowing *against* the boiler-room side of the house it is thought that no trouble will be experienced with this flue, especially if the doors between Room A and the boiler room should be left open.

It is not likely that the radiators placed on the ceiling of the basement will affect the matter at all nor is it thought that the correspondent's suggestion of capping all the flues at the top into a contracted opening, as shown in Fig. 2, will give any relief. The usual result of such procedure is the pulling down of the smoke from the other flues into the reversed flue resulting much more disagreeably than when only cold air is drawn down as at present.

As near as can be judged from the sketch, the most satisfactory solution of the trouble will probably be found in providing a ventilator top of the positive suction type and connected to the reversed flue alone. This will not interfere with the action of the two other flues now said to be working properly and the gain made is all applied to the flue giving the trouble. Also

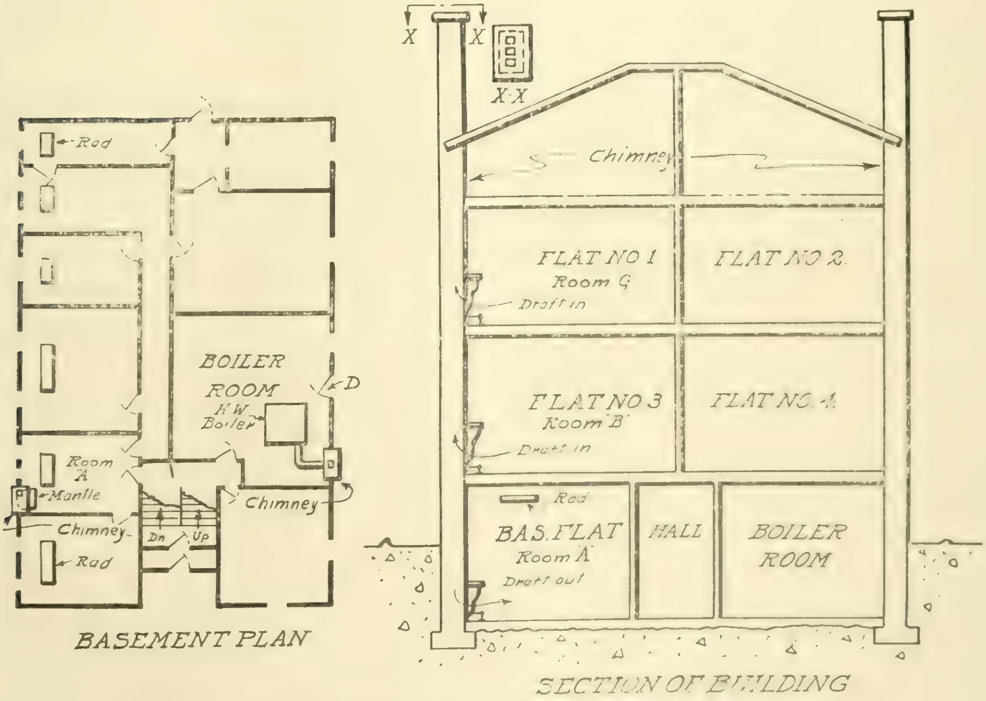


FIG. 1—SKETCH OF BUILDING WITH BACK DRAFT IN CHIMNEY.

investigate the matter of the draft going up the rear hall stairs and close any opening at the top of same. Take a good cigar with you and follow the smoke until you find out where the air is going—for air which *comes in* down the flue must *go out* somewhere.

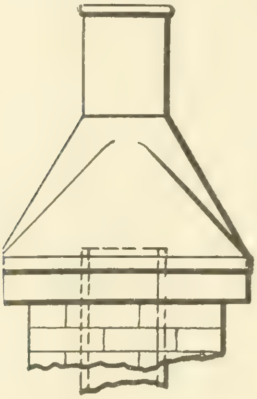


FIG. 2—POOR WAY OF CAPPING FLUES INTO A CONTRACTED OPENING.

Also look into the matter of making the boiler-room door fairly air tight and, if necessary, place a small register face in the outside door panel of door "D" to supply the air necessary for combustion. In conclusion, it might be said the reverse drafts in outside chimneys from fire-places are rather common due to the chimney getting chilled between times when the fire-places are out of use.

Examination for Heating and Ventilating Engineer.

Minneapolis, Minn.—The Civil Service Commission of Minneapolis will hold an examination, in January, for the position of Mechanical Engineer, to take charge of the work of the Board of Education in reference to laying out plans for mechanical equipment for the school buildings, in connection with the Board's architectural department. Inquiries will receive prompt attention. The salary has been tentatively fixed at $2400.00 per year. Civil Service Commission, 111 City Hall, Minneapolis.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Cantonment Heating and Ventilation Discussed By Illinois Chapter.

The heating and ventilation of army cantonments were taken up at the November meeting of the Illinois Chapter which was held at the Engineers' Club. November 13. Dr. Arthur R. Reynolds, formerly Chicago health commissioner, who was the first speaker, had some warm words of praise for the astonishing progress made by the government in the construction of the camps. He advocated the two-men-in-a-room plan for cantonments in order to insure healthful conditions.

William J. Mauer, the next speaker favored the army squad type of barrack, each building to house eight men, as described in THE HEATING AND VENTILATING MAGAZINE for November.

It was voted to discuss, at future meetings of the chapter, the papers that had been prepared in past years dealing with standards for heating and ventilation.

Nearly 40 members and guests were present.

Kansas City Chapter Urges Fuel Conservation in the Home.

A timely discussion of ways to save fuel was the feature of the November meeting of the Kansas City Chapter, held at the University Club, Kansas City, November 9. Upon completion of the business session President De Boos turned over the meeting to F. J. McMorran, who was chairman for the evening.

Speaking to the subject of "Fuel Conservation in the Home," W. N. McIntyre took up the proper handling of hot air and steam heating plants in residence and apartment house installations. He stated that the economical operation of the plans was dependent upon three things: keeping the fire surface clean, maintaining the proper draft and putting coal on the fire at the proper time. In maintaining the proper draft the air leakage around the furnace must be stopped and the proper handling of the drafts carefully followed. The efficiency of the furnace is greater when the coal is burned slowly than when it is forced, and the proper size of grate must be installed to insure proper rate of burning and a comfortably heated house.

F. A. DeBoos followed with a paper on the same subject. He showed the importance of keeping the air from outdoors from entering the basement, thus cooling the floors and basement generally. He advocated weatherstripping all windows, but this was the subject of some discussion as affecting the ventilation of the home. He emphasized the importance of proper draft and the effect of a dirty flue as obstructing this. The proper size of the furnace to secure the required amount of heat with the most economical coal consumption was discussed. He added a list of "Do's" and "Don'ts" on good furnace operation that brought forth considerable discussion. It was agreed that this subject of proper operation was one in which the Chapter could take an active part and it is their intention to work out a series of suggestions along this line to place before the home-owners of Kansas City. This work is to be carried on by the publicity committee, of which John Pease is chairman, the other members of the committe being Benjamin Natkin, F. A. De Boos, John H. Kitchen and F. A. Griffin, Jr.

The second subject for the evening was the "Heating and Ventilation of Moving Picture Shows, Theatres and Churches." Mr. McMorran opened the subject with a paper on the standards of heating and ventilating in public and semi-public buildings as worked out by the Society. These standards are given as minimum requirements and cover the proper amount of floor space, the proper amount of air and the proper change of air per person. E. A. Cline followed with a paper on the split system of heating for such buildings. He outlined the method of arranging inlet and exhaust ducts, fans and heaters and explained the method of taking care of certain problems occasioned by the stage and raising curtain. Discussion of the solution of these problems ensued and was followed by a paper by R. L. Dunlap on the furnace fan system of handling such buildings. The conditions where the heating problem and where the ventilating problem controlled the size of the plant were outlined and some details of installations given.

A well-gotten-up chapter programme for 1917-1918 has been issued by the Kansas City Chapter, containing, among other things, a list of topics to be presented throughout the winter, at the chapter meetings which are held the first Friday of each month. For the December meeting the topics were wind leakage and hot water heating for domestic purposes. The other topics are as follows:

January 4, 1918: "Heating and Ventilating Army Camps and Cantonments," B. Natkin, chairman. (Mr. Natkin designed part of the heating plant at Camp Funston, erected under the supervision of Lieutenant Foster and installed by F. J. Sellers).

February 1, 1918: "Heating and Ventilation of Hospitals" and "Comparative Costs of Heating with Different Kinds of Fuel," Walter E. Gillham, chairman.

March 1, 1918: "Cooling and Refrigerating Systems," F. A. De Boos, chairman.

April 5, 1918: "Heating and Ventilating of School Buildings," John H. Kitchen, chairman.

May 3, 1918: "Comparison of Hot Water, Vacuum and Vapor Vacuum Sytems of heating," John Pease, chairman.

The membership list contains forty names, with five members in military or naval service, as follows: C. A. Bennett and Leslie Byson, at U. S. Navy Yard, Puget Sound; F. Chockley, in Engineers' Corps, Fort Sill, Okla.; B. D. Foster, lieutenant; and F. C. McIntosh, with the Sixth Nebraska Infantry at Fort Deming N. M.

The chapter tendered a luncheon on November 19, at the City Club to H. W. Booth, Kansas City manager of the United States Radiator Corporation, who was leaving for Chicago to take charge of the company's Chicago branch. Mr. Booth was succeeded by H. M. Hillman, who up to that time had been connected with the company's New York branch.

New York Chapter Hears About the Fuel Situation.

Some first-hand information concerning the fuel situation in the East and the urgent need of awakening the public to ways in which coal was being wasted held the attention of a large gathering at the November meeting of the New York Chapter, held November 19, in the rooms of the Building Trades Club.

The principal speakers were Arthur F. Rice, commissioner for the Coal Merchants' Association of New York; William M. Mackay, George D. Martin, president of the National District Heating Association and Perry West.

Mr. Rice stated that the normal consumption of coal in New York during the heating season was 6,000,000 tons, or 30,000 tons per day. He said there was at present an inordinate demand for coal due to the large increase in the number of industrial plants, which was accompanied by a car and labor shortage.

He suggested the resizing of coal so that it would not be necessary to have so many separate storage bins for the various sizes. Almost all coal entering New York comes by boat and it would relieve congestion if stove and chestnut, for instance, could be stored in the same bin, the same applying to No. 1 and No. 2 buckwheat.

The lack of sufficient storage room for coal, he said, in large office buildings, is a most serious matter, it being quite common to find an office building with room for but one day's supply. Many hotels, also, have to be supplied daily.

He said one effect of coal price regulation by the government was to make steam coal abnormally high as there were no restrictions on the prices of the steam sizes. He thought the price of soft coal would have to go to $3.00 per ton because, he claimed, the government went too far in reducing this price. The price of anthracite, he said, was fixed higher than was expected, although he considered that the domestic sizes are not too high.

As a matter of fact, he said, chestnut is being used on buckwheat contracts, due directly to the lack of restrictions on the price of the steam sizes.

Mr. Rice then took up the many ways in which heat and light is wasted in hotels and office buildings. He also spoke of street lights he had seen burning at 8 a. m. A campaign of education is needed, he said, among small consumers.

W. M. Mackay said that some churches had arranged to hold their week day meetings on the first and third days of the week only so that the heating plants could be shut down the remainder of the week. He also recommended a lower temperature in the schools. He considered that damping the fire at night was not ordinarily an economical proposition. Where draft and grate permit Mr. Mackay recommended the burning of cheaper grade of coal.

George W. Martin, the next speaker, said that the National District Heating Association is working up a set of rules for conserving steam to be sent out to consumers generally. He recommended the appointment of a committee to prepare similar rules to be turned over to the Building Managers' Association.

Americans, he said, practice great wastefulness in the use of heat and light. Great clusters of lights will often be found burning in broad daylight.

On the matter of intermittent heating his own observation was that under some conditions the heating plant can be shut down and coal saved thereby. He cited the case of a large department store in which the night temperature had risen to 85° before the practice was adopted of shutting down at night.

We do not properly educate firemen, he added, and sometimes the building engineer is to blame for fuel waste. He instanced one case where the pressure always went down during the cleaning of the fires. It was suggested that the refrigerating plant might be shut down during that period. This was done with satisfactory results, but the engineer had never thought of doing it.

Perry West said the engineering department of the Newark Board of Education was sending experts around instructing the firemen in the public school plants. He suggested that the present was a very good time for getting away from "hothouse" standards of heating.

In addition to practicing economy, he said, it is important to eliminate unnecessary demands for heat. In this connection he urged no mechanical ventilation in the early Fall and Spring, the cutting off of heat in stairways and corridors except in extreme weather, consolidating the activities of the school classes, and perhaps eliminating some of such activities; and adjusting the human elements, that is, assembling the poorly-clad children in such a way that they could be in the warmer rooms.

Mr West said one important source of fuel economy was to keep the fires properly proportioned to the load. In this connection it is good practice to have dampers on the boilers in addition to the automatic dampers. He said Newark had saved $7500 in one year through regulation of the fires, or 25% of its total fuel cost for the year.

He urged the graduating of the temperature according to the outside conditions and suggested the following scale depending somewhat on the humidity and "rawness" of the outdoor air.

Outside Temperature Deg. F.	Temperature of Air Entering Room Deg. F.
0	70
30	60
40	64
50	62
60	60

Arthur K. Ohmes, discussing the topic of the evening, said in Switzerland they are holding one school session a day. The same is true in Holland. In addition the children are taking their vacation in the winter time to save coal and are going to school most of the summer.

Walter S. Timmis declared that the real responsibility for the high temperatures in the home belongs to the ladies who insist on wearing summer finery in winter weather.

On his motion is was voted to have the chapter, through its officers, get in touch with the mayor and find out if the chapter could be of any assistance in preparing specific recommendations on the matter of fuel economy for general distribution throughout the city.

In connection with "standard" heating temperatures, W. L. Fleisher said that the catalogues of boiler manufactures reach a greater proportion of the general public than is reached by heating engineers and that such catalogues invariably give the 70° indoor standard. He thought one of the first steps should be to induce the boiler manufacturers to change the wording of their catalogues.

Before adjournment it was announced that the December meeting would be devoted to high temperature drying.

It was also announced that a series of lectures on heating and ventilation is being conducted at the Bronx Y. M. C. A. on Wednesday evenings, beginning December 5.

New Publication.

An Investigation of Pipe Corrosion is the title of Bulletin No. 30, issued by the A. M. Byers Co., Pittsburgh, Pa. The investigation was prompted by local agitation on the part of property owners who charged that chemicals were being used in the water filtration plants which destroyed the piping to such an extent that not even brass was immune. This subject was taken up by the Pittsburgh Board of Trade, and a report rendered which showed that no chemicals were used which could in any way be held responsible for the trouble, but the thought was expressed that the city should not be held responsible for the fact that much pipe of inferior quality had come into use in recent years.

In order to determine the life of pipe under varying conditions of service, Thomas F. Payne, a sanitary engineer, of Pittsburgh, was commissioned by the A. M. Byers Company to make a house-to-house canvass of buildings, "with a view to ascertaining all the pertinent facts which might aid property owners in meeting the rust question in the most efficient manner." After several unsuccessful atempts to obtain accurate data from private residences and other buildings, it appeared that apartment buildings offered the best field for investigation, and 125 such buildings, all in Pittsburgh, were investigated. A tabular statement gives the name and location of each apartment building investigated, the year of its erection, the length of time which both hot and cold water lines of brass, steel and wrought iron had been in service, where rusted out and their present condition where still in service.

The investigation showed the corrosion to be most severe in hot water mains (exposed basement piping) and the recommendation is therefore made that pipe one size larger than that used in regular practice be used. The larger size, having a greater thickness and larger bore, would not so easily rust through or become stopped with rust.

The hot water risers, which are usually concealed, proved to have a much longer life than the basement mains. It is therefore a question whether the practice of specifying brass pipe for risers, and iron or steel for mains, might not better be reversed. Brass pipe in this investigation did not show up as well as might be expected, and many complaints were heard on that account.

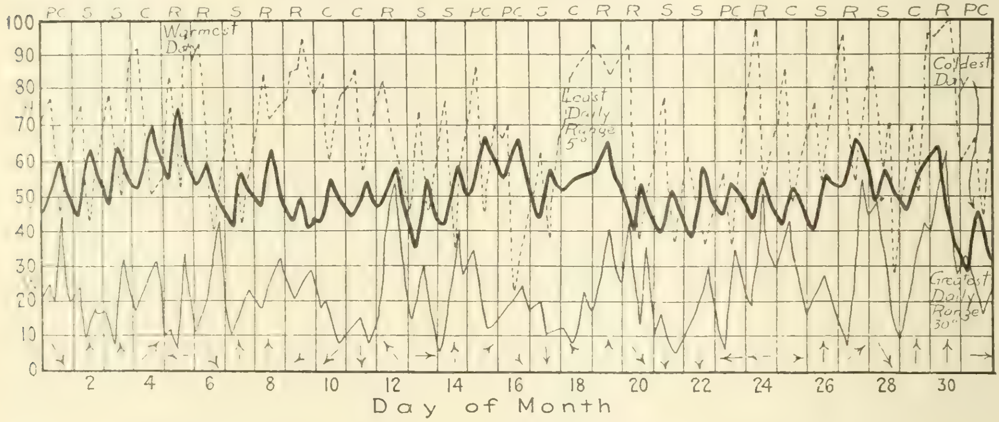
Genuine wrought-iron pipe, in 65 buildings, ranging in age from 8 to 20 years, did not show a single failure when used for cold water supply, and in only one or two of these buildings did the wrought-iron hot water risers require any repairs in the same period of time. Lead pipe, for hot water risers, seem to have an average life of 18 years, one complete failure being recorded after 14 years' service.

It appeared from the investigation that the pipe lasted a little longer where an automatic water heater was used. This undoubtedly is due to the possibility of maintaining a lower temperature of the water than with a heater not having a thermostatic control, for corrosion increases with the temperature, reaching its maximum between 140° and 170° F. Temperatures from 115° to 130° F. are therefore to be recommended wherever they will serve the purpose.

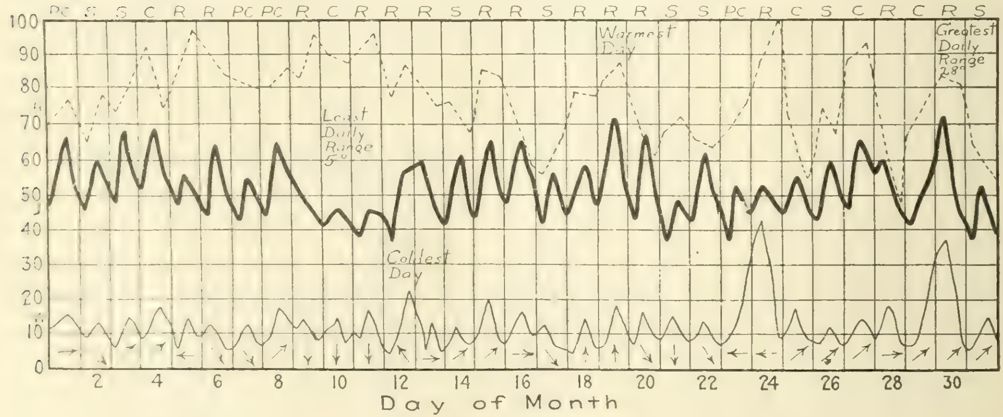
The rusting out of pipes is one of the prolific sources of trouble for the heating engineer and he will welcome any research work on this subject. A copy of the complete report can be obtained from the A. M. Byers Company by asking for Bulletin No. 30.

The Weather for October, 1917

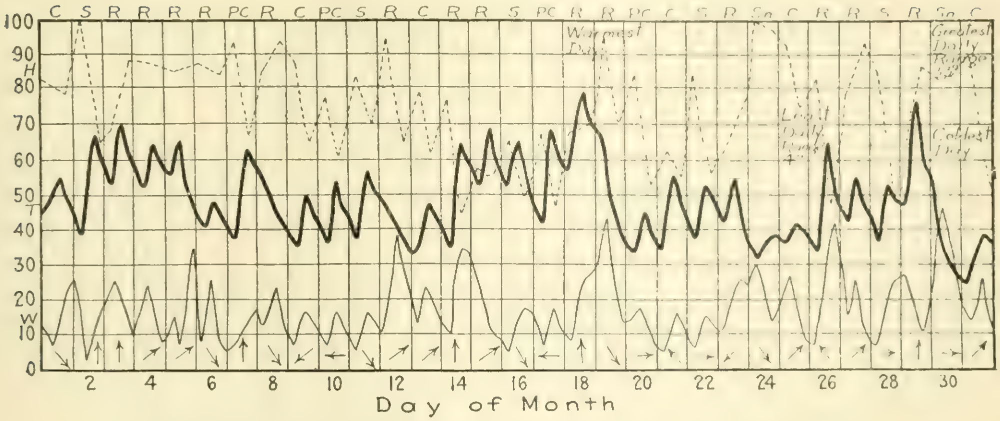
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	74	71	79	69	85
Date of highest temperature	5	19	18	18	15
Lowest temperature, degrees F.	29	37	26	23	25
Date of lowest temperature	31	12	30	30	30
Greatest daily range, degrees F.	30	28	33	29	34
Date of greatest daily range	30	30	30	28	18
Least daily range, degrees F.	5	5	4	4	10
Date of least daily range	18	10	25	24	24
Normal temp. for month, degrees F.	52	52	49	45	51.1
Normal mean temp. for month, deg. F.	55.6	52.3	54.9	53.2	58.4
Total rainfall, in.	5.68	5.33	5.27	3.96	1.87
Total snowfall, in.	——	Trace	4.3	1.3	Trace
Normal precipitation, this month, in.	3.71	3.86	2.36	2.55	2.41
Total wind movement, miles	13791	8108	8849	9679	11227
Average hourly wind velocity, miles	18.4	10.9	11.9	13	15.1
Prevailing direction of wind	N.W.	S. W.	S. W.	W.	S.
Number of clear days	10	11	5	5	7
Number of partly cloudy days	8	6	7	5	14
Number of cloudy days	13	14	19	21	10
Number of days on which rain fell	10	14	16	21	10
Number of days on which snow fell	——	——	2	2	——
Snow on ground at end of month, in.	——	——	None	0.5	——



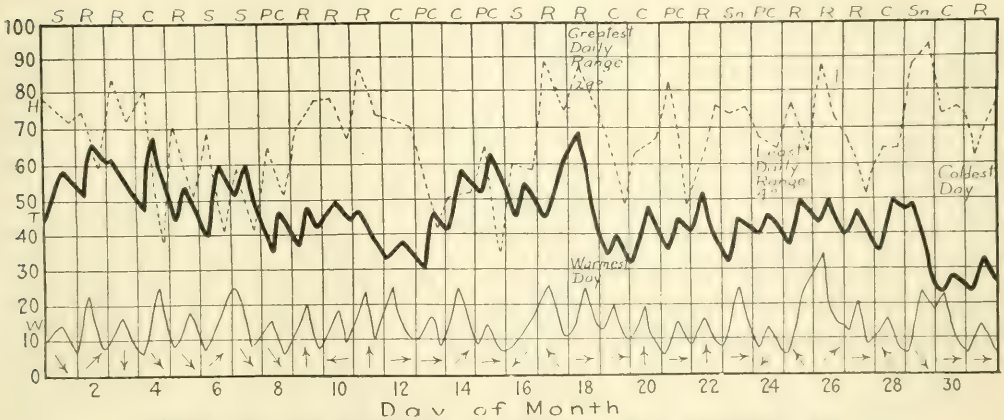
RECORD OF THE WEATHER IN NEW YORK FOR OCTOBER, 1917.
(Hourly Observations of the Relative Humidity Are Recorded on this Chart.)



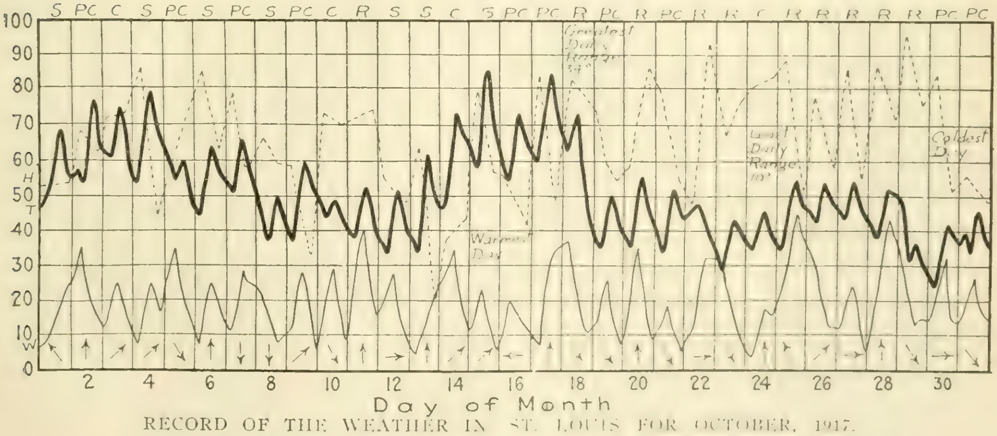
RECORD OF THE WEATHER IN BOSTON FOR OCTOBER, 1917.



RECORD OF THE WEATHER IN PITTSBURGH FOR OCTOBER, 1917.



RECORD OF THE WEATHER IN CHICAGO FOR OCTOBER, 1917.



RECORD OF THE WEATHER IN ST. LOUIS FOR OCTOBER, 1917.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

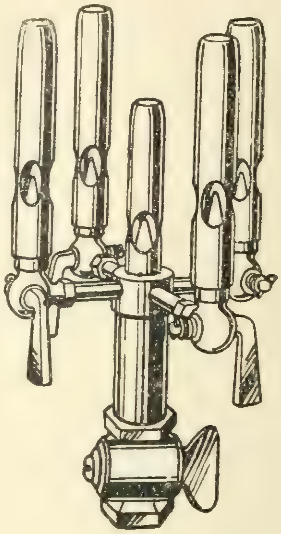
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

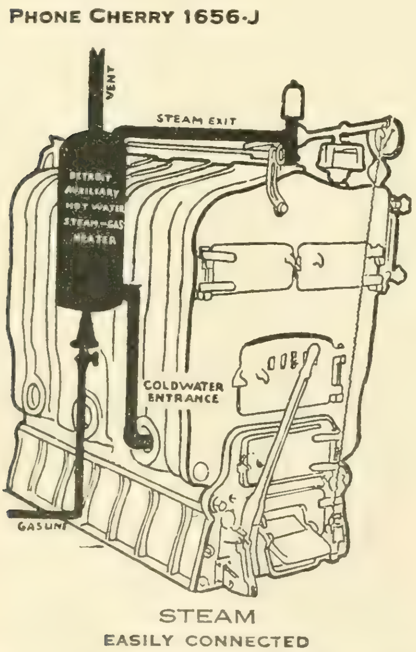
Trade Literature.

Marvel Temperature Regulators and other thermostatic control apparatus are brought to the attention of the trade in a new catalogue issued by the American Thermostat Co., Newark, N. J. These devices are featured as all electric and all automatic, doing away with piping, air pumps and compressors, liquid or diaphragm action and having no springs or weights. The Marvel regulators consist primarily of a thermostat and motor, operating in conjunction and using electricity as its immediate source of power. The motor is of the automatic, electric type, using either battery, or A. C. or D. C., 110-volt current, without the intervention or use of transformer of other voltage reducing device. Illustrations show the Marvel regulators as applied for district heating service, gas heater control, steam boiler control and gas and steam control. The device is made in various models, with and without time attachement. Size of catalogue 6 x 9 in. (standard). Pp. 24.

Detroit Gas Auxiliary House Heater, for use on either hot water or steam boilers, is an interesting device described in newly-issued circular matter received from the Detroit Heater Corporation, Adelaide Street and Woodward Avenue, Detroit, Mich. This device, it is stated, is capable of handling from 400 to 500 sq. ft. of radiation. The heater is built of flanged steel and tested to 50 lbs. pressure. The tubes and plates of cold drawn steel, are autogenously welded into a one-piece heater. It is 30 in. high, 8 in. wide and weighs about 40 lbs. The pipe connections are 1½ in., both ways. Special attention is called to the burner and it is pointed out how a heater may be ruined by a poor gas burner, due mainly to carbon deposits. The Detroit burner, it is stated, has the pressure and forms a highly-oxidized, hard green flame of intense heat. It is made of cold-drawn machined steel, rust-proof. Each bunsen burns 33 cu. ft. of gas per hour, with separate shut-off. The inner short tube burns 15 cu. ft. per hour and is controlled by a main gas valve and also acts as igniter for the others. Secondary air is admitted to the fire chamber by an air diaphragm. The heater complete, with burner, is listed at $75.00 and it is estimated the installation cost will be $10.00.



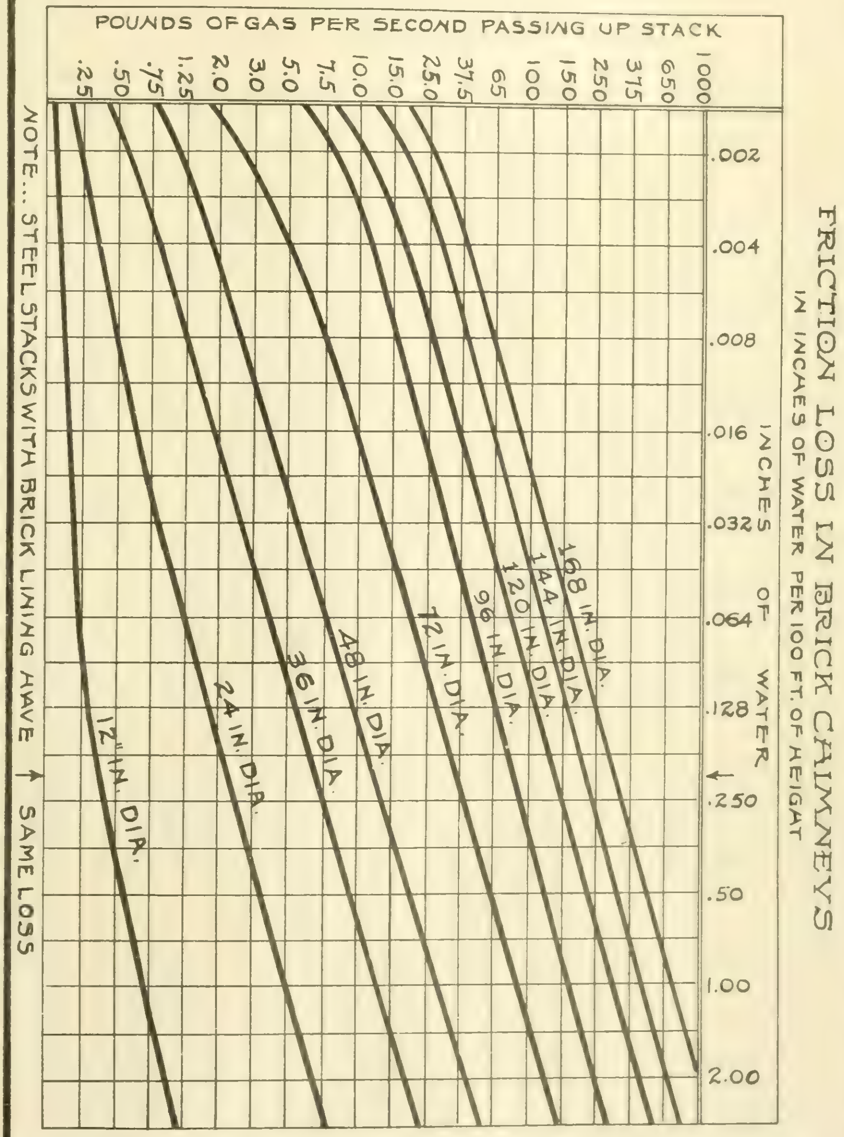
BURNER USED WITH DETROIT GAS AUXILIARY HOUSE HEATER.



DETROIT GAS AUXILIARY HOUSE HEATER.

Hydro Pressure and Draft Recorders are illustrated and described in a new catalogue (D) received from the Bacharach Industrial Instrument Co., Pittsburgh, Pa. Besides explaining the design and construction of these recorders, this pamphlet shows the different types of the Hydro draft and pressure recorders, together with the many uses and applications in the different fields of industry. Size 6 x 9 (standard). Pp. 8.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY-N.Y. CITY.



FRICTION LOSS IN BRICK CHIMNEYS

IN INCHES OF WATER PER 100 FT. OF HEIGHT

FOR ANY OTHER HEIGHT (H) OF STACK MULTIPLY TABLE LOSS BY $\frac{H}{100}$

FORMULA: $CF = G^2 \times .0019 \times H \times C \div A^3$ WHEN "CF" IS CHIMNEY FRICTION IN INCHES OF WATER, "G" THE WEIGHT OF GAS PER SECOND, "H" THE HEIGHT OF CHIMNEY, "C" CIRCUMFERENCE & "A" AREA ALL IN FEET AND .0019 A CONSTANT FOR BRICK CHIMNEYS & GASES AT 500° F.

HIMNEYS—DRAFT LOSS IN BRICK STACKS.

No 100-H

Chimneys

To summarize:

(*a*) Add together all friction losses (including those of the fire, boiler, breeching, turns, etc.) and allow 0.20 in. for chimney loss and 0.10 in. for safety. The result being the theoretical draft required to overcome all such losses.

(*b*) Read the required height of stack from the table of theoretical draft, using the line of proper elevation above sea level.

(*c*) Modify the loss in stack of 0.20 in. per hundred feet to suit the theoretical height found. Thus, for a theoretical draft requiring a stack 150 ft. high the 0.20 loss would become $0.20 \times \frac{150}{100} = 0.03$ and a new height must be re-read to offset the added friction.

(*d*) Read the diameter for brick or steel stacks on the basis of pounds of air per second handled and increase *area*—for heights above sea level—by percentage for increase of air volume.

NOTE: Measurement of the draft in a chimney is made by a draft gauge which, in its simplest form, is nothing but a glass tube of U-shape, one end of which is connected to the base of the chimney and the other end left open to the air.

The suction or draft of the chimney will raise water placed in the tube so that the water in the leg connected to the chimney stands higher than that in the leg open to the atmosphere, this being due to the unbalancd pressure and proportional thereto. The difference in level between the two columns of water is measured in inches, this difference being termed the draft in "inches of water." Some draft gauges have the legs of the U inclined only a few degrees off the horizontal so that a rise of small amount causes a large movement horizontally along the inclined tube on which fine graduations can be read.

To take a theoretical draft reading (which is the most accurate method to pursue) see that the temperature of the flue gases is known at the time of taking the reading and that a tight damper can be closed in the smoke pipe. Connect the draft gauge to the chimney, take the flue-gas temperature and then quickly close the smoke pipe damper and read the draft gauge as soon as it reaches the highest fixed point.

For points above sea level the readings will be *less* than that shown in the table, the percentages being for

2,000 ft.	97%
4,000 ft.	94%
6,000 ft.	92%
8,000 ft.	89%
10,000 ft.	86%

Thus, a chimney 50 ft. high and at 250° F. temperature at sea level should have a draft of 0.26 in., but at 6,000 ft. elevation it should have 0.26 × 92% or 0.24 in.

Chimneys

For example, suppose a steel stack, lined, at sea level is to be designed to serve:

Six—250 H.P. boilers, with four of them in service at 50% overload in extreme weather, or six in service at normal rating.

Coal to be burned, bituminous, run-of-mine;
Breeching, steel, 75 ft. long—square
Turns, one—90° up from boiler,
One—90° into the breeching,
One—90° towards stack and
One—90° up into stack.

Turning to Standard Data Sheet No. 100-C and assuming 5 lbs. of coal per horsepower, it is found in the columns under the heading "Pounds of Coal per Boiler H.P." and in the column under the heading "5" that 1,500 B.H.P. will require 7,500 lbs. of coal per horsepower (in the extreme left-hand column) and that the "Pounds of Air per Second" (in the extreme right-hand column) is 38.

If each boiler has 80 sq. ft. of grate surface, with six boilers in service, the total grate surface would be 6 × 80 sq. ft., or 480 sq. ft., but with only four in service the total grate surface would be only 4 × 80 sq. ft., or 320 sq. ft.

7,500 lbs. of coal 1/320 = 24 lbs. per square foot at 150% rating.
7,500 lbs. of coal 1/480 = 16 lbs. per square foot at 100% rating.

On Standard Data Sheet No. 100-D it is found that the fire loss for run-of-mine bituminous coal at 25 lbs. per square foot is 0.14 in. and, for 15 lbs. per square foot, 0.08 in.

The boiler loss may be assumed at 0.25 in., at full rating, or 0.40 in., at 150%.

Smoke-breeching loss totals:
0.1 × 75/100 = 0.075 for straight pipe
Four bends @ 0.05 = 0.20 for bends.
——
0.28 in. total for bends and breeching.

Assumed for stack, 0.2 in. per 100 ft. of height

The total draft loss is then equal at

	100% Rating Inches Water.	150% Rating Inches Water.
Fire	0.08	0.14
Boiler	0.25	0.40
Breeching	0.28	0.28
Stack	0.20	0.20
Contingencies	0.10	0.10
	0.91	1.12

From Standard Data Sheet 100-F the curve at sea level shows that the stack (for 100% rating) must be about 103 ft. high, increasing its friction loss to 0.2 in. × 103/100 = 0.21 in. making 0.92 total, requiring, possibly, 103 ft. actual height. As the stack is lined, the friction loss will be the same as a brick chimney and on Standard Data Sheet No. 100-H the point under the arrow and opposite 38 lbs. of air per second is found to be almost on the 72-in. line, this diameter of stack being correct for the 100% rating.

For 150% rating, by similar procedure, the required height of stack is found on Standard Data Sheet No. 100-F to be 127 ft. and the friction loss will be 0.2 × 127/100 = 0.25, or 1.17 in. making about 130 ft. height required. Since, under these conditions, the chimney friction loss is 0.25 in., by referring to Standard Data Sheet No. 100-H—opposite 38 lbs. of air per second and under 0.25 in. loss, the intersection falls on 72 in. diameter exactly. This shows that the diameter is the same in each case because, of course, the quantity of gas is the same, but the height must be increased when forcing the four boilers to 150% of their ratings.

Now suppose this stack were to be located at a point 5,000 ft. above sea level. Then the theoretical draft must be 1.12 in. as before, but, referring to Standard Data Sheet No. 100-F, it is found that 5,000 ft. requires a stack 158 ft. high. The friction loss is then 0.2 × 158/100 = 0.31 in. and this will increase the total friction by 0.31—0.2 or 0.11 in., making 112 + 0.11 = 1.23 in. This re-applied to the curve shows a stack actually required 172 ft. in height

Then, with a stack friction of 0.31 in. of water, on Standard Data Sheet No. 100-H, under 0.31 in. and opposite 38 lbs. of gas per second is found a point close to the 72 in. diameter line. Reference to the table on Standard Data Sheet 100-E shows that the volume at 5,000 ft. is increased 20%. The area of a 72-in. stack is about 28 sq. ft. which, increased by 20%, is 28 + 28 × 0.2, or 33 sq. ft. which is about a 78-in. stack.

CHIMNEYS—EXAMPLE FOR STEEL STACK. **No. 100-J**

Chimneys

COSTS

As far as the cost of chimneys is concerned, this is a rather variable amount and depends on the material of construction, the foundation necessary, location of job, etc. The ordinary materials of construction are common red brick, radial brick, steel and concrete. Steel stacks are divided into lined and unlined or partially lined and also into self-supporting and guyed stacks. Steel is the most unstable of the materials mentioned, these stacks lasting 10 to 12 years and requiring frequent painting; they rust rapidly when not in service. Lined steel stacks have a lining of fire brick to protect them from the action and heat of the gases contained.

Brick stacks last a long time, while concrete is practically indestructible if properly erected. Radial brick chimneys are built of special radial brick which have five or six holes about 1 in. in diameter running through them vertically.

The cost of chimneys per horsepower will run about as follows for the maximum horsepower which they will handle:

Up to 100 ft. high	4 ft. to 6 ft. dia.,	$2.50 to $4.50 per H.P.
Up to 125 ft. high	6 ft. to 12 ft. dia.,	2.30 to 3.75 per H.P.
Up to 150 ft. high	8 ft. to 14 ft. dia.,	1.75 to 2.75 per H.P.
Up to 175 ft. high	10 ft. to 14 ft. dia.,	1.75 to 2.00 per H.P.
Up to 200 ft. high	12 ft. or over dia.	2.00 per H. P.

If the cost of a radial brick stack be taken as unity the comparative cost of other constructions will vary about as follows:

	Cost per Horsepower
Radial Brick	1.00
Common Red Brick	1.25
Steel,—self-supporting,—lined	1.23
Steel,—self-supporting,—partially lined	1.14
Steel,—self-supporting,—unlined	.86
Steel,—guyed, lined	1.00
Steel,—guyed, partially lined	.80
Steel,—guyed, unlined	.60

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- Chicago Commission on Ventilation—ventilation tests in the Lewis-Champlin School, Chicago, Dec.
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  economical purchase and use of bituminous coal for heating homes (University of Illinois), Aug.
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